Stories of learning: Inquiry-based pathways of discovery through environmental education

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Abstract: In our work in environmental education (EE) as part of formal schooling we partnered with local schools to explore the practice of embedding, or integrating EE within formal school curriculum using inquiry-based pedagogies. In this paper we report on and discuss our growing understanding of the practice of pedagogical documentation and the subsequent creation of learning stories within the context of EE. Our thinking is focused on how teacher practice in the use of learning stories might strengthen student self-determination in inquiry-based environmental education opportunities. We describe the E4E (Educating for Environment) school project, and provide samples of learning stories as evidence for analysis and discussion. Working with a grounded theory approach, we propose that student thinking in inquiry-based contexts might follow one or more of five thinking/learning pathways (reasoning, propositional, action-oriented, metacognitive and emotive). We close with comments on the benefits to students and educators alike, when we merge EE with learning stories.

Subjects: Classroom practice; Continuing professional development; Curriculum studies; Education studies; Educational research; Primary/Elementary education

Keywords: environmental education; inquiry-based learning; pedagogical documentation; learning stories; self-determined learning

ABOUT THE AUTHORS

Jeff and Astrid are professors in the Faculty of Education at Nipissing University, and Lotje is Program and Outreach Coordinator with the Near North District School Board in Ontario. Together they have provided leadership in the E4E (Educating for Environment) research project(s) outlined in this paper. In the third year of the project, and encouraged by the practice of pedagogical documentation already being utilized by the classroom teachers with whom they were working, they explored how Learning Stories might document the E4E project. The Learning Stories crafted for the various E4E activities demonstrated that such stories can capture the transformative nature of environmental education. They look forward to further investigating the possibilities, for educators and learners, that emerge as inherent in Learning Stories.

PUBLIC INTEREST STATEMENT

Wonderful learnings for students and teachers can emerge when environmental education is integrated into school curricula, and learning stories are created. The depth of student thinking and feelings are revealed when learning is driven by the student’s interests. In the E4E (Education for Environment) school project, students were provided with many opportunities for inquiry-based learning, both indoors and out, in ways that connected to their school subjects, while letting them explore topics of interest to themselves individually. Students and their educators focused careful attention on their words and actions during the learning experiences. Learning pathways unique to each student emerged. Learning stories, created by the educators and presented in text and photos, provide opportunities for reflection on the many learnings that took place.
1. Introduction
As humans, we are inextricably linked to the planet on which we live; its health and well-being determine our own. We believe that education about the interconnections between humans, environments and others is a vital requisite to living sustainably now and into the future. To that end, much of the work that we do is founded on elements of environmental education (EE), both formal and informal, indoors and outdoors. We are not alone in this conviction. As the UN Decade of Education for Sustainable Development has recently come to a close, the language and practice of environmental and sustainability education has become a common element in many conversations about curriculum and pedagogy.

Our work in EE as part of formal schooling led us to conduct a research project titled E4E (Educating for Environment) in which we worked with local schools to explore the practice of embedding, or integrating EE within formal school curriculum using inquiry-based pedagogies. The three-year project had a variety of foci that emerged over time as the project evolved (Authors, 2014). In this paper we report on and discuss our growing understanding of the practice of pedagogical documentation and the subsequent creation of learning stories within the context of EE. The combination of EE pedagogies (Smyth, 2006), and documentation based on the Reggio Emilia approach (Edwards, Gandini, & Forman, 2011) was compelling. Students found themselves with considerable agency over their learning in terms of choice of subject, of the direction of inquiry, and the opportunity to share thinking with others. We explored the concept of reciprocal learning pathways that are facilitated by the educator as provocateur, but based on the curiosity and wonderings of students.

The paper begins with a review of literature addressing the relationship between EE and formal curriculum, particularly in Ontario where our research takes place, while describing the historical context of pedagogical documentation as it relates to learning stories. We go on to describe the E4E project, and then provide samples of learning stories as evidence for our analysis and discussion. Working with a grounded theory approach to our analysis, we propose that student thinking in inquiry-based contexts might follow one or more of five thinking/learning pathways (reasoning, propositional, action-oriented, metacognitive and emotive); these are detailed in the analysis and discussion section of the paper. We close with comments on the benefits to student agency and educator practice, when we merge EE with learning stories.

2. Literature review
In this paper we focus our thinking on how teacher practice in the use of learning stories might strengthen student self-determination in inquiry-based environmental education. That is, we bring together several essential components—EE, learning stories, teacher practice, and student learning in order to understand how they might interconnect to support and encourage student agency. Each component plays a role in the hoped-for outcome, which is student engagement, as evidenced by enthusiasm and participation, emotional responses, and changes in behaviour (Reeve, Jang, Carrell, Jeon, & Barch, 2004).

We consider our work through the lens of student autonomy or self-determination, a pedagogical position that allows pursuit of inquiry in directions that interest and engage the student. Self-determination theory, as described by Deci and Ryan (2012), is predicated on the notion that humans are “inherently active, intrinsically motivated and oriented toward developing naturally through integrative processes” (p. 417). If this is the case, then teachers should be supporting these inherent learning traits, rather than suppressing them. Supporting students’ inherent learning processes include: supporting feelings of competence by providing opportunities for challenges successfully met; supporting a sense of autonomy by providing and supporting choices; and, fostering a sense of belonging within a social group or classroom (Darner, 2009).

The following review of literature focuses on two aspects of education that are the foundation of our thinking in reporting on our research project: the nature and utility of EE in Ontario curriculum, and the evolution and value of pedagogical documentation that leads to the creation of learning
stories. We connect both of these aspects to the foundations of student self-determination—competence, ability to make choices, and a sense of relationality, either to a group or to environment.

2.1. Embedded environmental education

Environmental education is understood in many different ways; for some it means developing a comprehensive catalogue of natural history information, while for others it entails developing a profound understanding and advocacy for, about and in nature. It can be place-based, have an environmental-social justice focus, or delve into the ethics of sustainability. Lucy Sauvé, in her (Sauvé, 2005) typology of EE, describes 15 variations, or currents of EE as they are practised by educators and other EE practitioners; these currents include, among others, scientific, holistic, feminist and ethnographic.

However, for the purposes of education, generally it is agreed that through a variety of learning experiences both in and out of doors, EE should provide students with the knowledge and skills to become citizens who are able to work towards finding a balance between human agency and the preservation of the natural environments of the planet (Gruenewald & Manteaw, 2007; Hungerford, Peyton, & Wilke, 1980; Smith & Wheeler, 1999; Smyth, 2006). In Environmental Literacy, David Orr (1992) makes the often-quoted statement, “All education is environmental education ...” (p. 90) and while perhaps an overstatement, it nonetheless should provide pause for reflection.

Environmental education pedagogies have the capacity to support student self-determination with a strong focus on student-driven inquiry (Palmer, 1998; Smyth, 2006) by giving students opportunity to make a decision about what they feel is important enough to spend their time and energy considering; that is, wondering about, talking about, theorizing about, researching, documenting and sharing. Smyth (2006) points out that the nature and practice of EE differs from more traditional approaches to education (p. 253) and describes EE pedagogies with an eye to the role of student-driven inquiry: holistic and learner centred; problem formulating; systemic rather than linear thinking; the affective integrated with the cognitive; issue-based and action oriented. In fact, Smyth suggests that EE pedagogies are “attrac(tive) to reformers of education whose priorities are not necessarily environmental” (p. 253) as they move away from the traditional teacher-centred, reductionist, discipline-based models of teaching and learning.

In Ontario, EE has been repositioned in the K-12 curriculum, initiated by the report of Ontario Curriculum Council’s (2007) (also known as the Bondar Report) that defined EE as “education about the environment, for the environment and in the environment” (p. 6). Subsequently, the recommendations made in the Bondar report were reframed in the 2009 policy document Acting Today, Shaping Tomorrow; A policy framework for environmental education in Ontario schools, which called for EE expectations and topics to be embedded across all subjects, disciplines and grades (Ontario Ministry of Education, 2009). Nonetheless, a requirement for certain curricula to be included by a teacher does not mean that topic will be well taught, or well learned, and this is particularly true of EE. Although inquiry-based learning has become pervasive across revised curricular documents in Ontario, it has not necessarily entered classroom practice pervasively.

2.2. The evolution of learning stories

Under the leadership of Loris Malaguzzi, an Italian educator and passionate educational psychologist, a noteworthy pedagogy was introduced in the field of early childhood education, and then further developed in the 1970’s and 1980’s (Hewett, 2001; Wien, 2013). The new pedagogy was unique in that it considered children as capable architects of their learning journeys; the role of the student was (re)positioned as one that was “beautiful, powerful, competent, creative, curious and full of potential and ambitious desires”; (Hewett, 2001, p. 96). Certainly Deci and Ryan’s (2012) assertion that humans are inherently motivated to learn echoes Hewett’s thinking. Because it was launched in the town of Reggio Emilia in Italy, this progressive pedagogy and underlying philosophy is referred to as the Reggio approach. Its distinctive child-centred perspective provides opportunity for educators to (re)consider their relationships with their students, and of their roles as facilitators of learning.
As well as the importance of observing the student interacting in relationship with their learning environment as the third teacher (Ontario Ministry of Education, 2012b).

With the capable, curious, competent student at the centre of this pedagogy, the Reggio approach fosters an environment for learning that nurtures wonder, where students observe, question and articulate their thinking about theories and ideas that matter to them, as unique explorers of their world. Concurrently, the educator becomes the “provocateur” who: responds to, extends and challenges the student’s developing theories; the guide who encourages exploration; and, the researcher alongside the student, observing the learner interacting within the social and physical environment. The educator studies the process of learning unique to each student in an effort to refine pedagogical understandings in collaboration with educators, parents and the learners themselves. Educators explore topics of interest with the student and from the perspective of the student, as they weave a living, collaborative relationship with them in the context of their evolving, shared and co-constructed environment. The Reggio approach comes from the perspective that learning is a social activity that spurs inquiry. Thus, rather than taking the lead role, educators listen to and observe their students as they engage mindfully in learning experiences (Carter, 2010). The collaborative practice of observing, noticing, interpreting, analysing, reflecting and planning ensures that educators are responsive to the curiosity and wonderings of the learners; that learners are honoured on their educative journey.

Professional learning though the Reggio lens involves educators documenting their observations of students as they learn, collecting data-sets that tell the story of learning moments of individuals in relationship with others and their environment. Data-sets might include photos, videos, audio transcripts, and student artefacts (Ontario Ministry of Education, 2012a; Turner & Wilson, 2010; Wien, 2013). Educators, potentially in collaboration with their students then cull the images that make the story visible, and visually display the data, most often in the form of posters, using photos, transcript excerpts from audio and video data, and artefacts, for the purpose of further discussion, analysis and reflection with and amongst students and educators (Hewett, 2001; Wien, 2011, 2013). Pedagogical documentation is the term used to encompass the collection, display and analysis of both qualitative and quantitative data to make thinking and learning visible, and although more widely practised in early childhood settings, it is being explored from Kindergarten to Grade 12 in education in Ontario, Canada using twenty-first-century technologies (as evidenced by numerous publications by the OME, see Ontario Ministry of Education, 2016 as an example) and worldwide (Edwards et al., 2011).

Educators elicit information about children’s learning by collecting evidence of it through observations, conversations, and demonstrations of learning. Documenting the evidence of learning is the most important aspect of assessment in Kindergarten and is, indeed, an integral part of all assessment approaches. When educators review and reflect on the documentation with the children, they have opportunities to name and co-construct the learning with them. As the documentation accumulates over time and educators and children reflect on it daily, children begin to internalize the learning and apply it in other contexts. Educator teams analyse the documentation to determine the growth of the child’s learning in relation to the knowledge and skills identified in the overall expectations set out in The Kindergarten Program. (Ontario Ministry of Education, 2016)

A notable element of pedagogical documentation is the required shift, by educators, in their attitudes towards, and their relationships with, their students (Carter, 2010; Turner & Wilson, 2010); “…to engage in this reinterpretation of what it means to be a teacher and learner”. (Turner & Wilson, 2010, p. 6). Through reflection, educators become conscious of their own values and biases, and this pedagogical listening refines practise. So too, through the mindful observation of learning and learners, the learners become our teachers.

An extension of pedagogical documentation has been the development of learning stories, which are summative photo and text narratives highlighting moments in time, and are based on the data
collected during the process of documentation. Formalized learning stories arose from the New Zealand’s Maori oral traditions (Carter, 2010) and have found a place amongst other documentation and assessment strategies. Learning stories include photos, video transcripts, narratives (of the students, educator[s], and parents), observations, and descriptions of the context, that focus on pivotal moments in the learning process (Southcott, 2015). At minimum, the learning story has a title that evokes curiosity, a description of context of the learning experience, and the impact of the experience on the thinking of the students and educators.

(Learning stories) not only highlight the actions of the child, but also illuminate how educators support the child and extend learning. In this way, learning stories have the potential to reveal the reflections and actions of both children and educators in the classroom, capturing the complexity of learning and teaching. (Southcott, 2015, p. 35)

The moments chosen for documentation reflect the documenter’s/observer’s/educator’s own wonder and curiosity, alongside that of their student’s:

The learning in learning stories is twofold: teachers come to understand how their own thinking is being shaped at the same time as they learn about children’s thinking. It becomes a learning story nested within a learning story. (Southcott, 2015, p. 35)

2.3. How learning stories are used
Learning stories are narratives that hint at a storyline, at reflexive relationships rather than traditional transmission of information, or quantitative assessment, from educator to student (Wien, 2011; Woodhouse, 2011). Learning stories should be easily displayed and are often viewed as posters; they should be visually appealing and legible, and focus on a particular learning pathway. As such, the learning story provides a starting point for intentional and focused conversations—between students, educators and parents—with potential to: reveal the thinking and learning process of the students (ibid); provide a formative assessment of student progress and development (Pride, 2014); identify emotional responses to the learning experience (Carter, 2010); and strengthen the mutual learning relationship between educator and student (ibid).

A learning story as an artefact of pedagogical documentation allows educators to reflect with intention on a learning moment, to study it and to deepen their understandings of each learner’s strengths and perspective as they theorize in order to understand their world. Each story is unique to the context of the moment being documented; relationships are revealed—the relationship of the learner with their environment, with others engaged in the learning, and with the documenter as learner and teacher. As the educator listens and notices the subtle nuances and powerful moments of learning individual to the student, the uniqueness of their gifts are realized.

Making a learning story public (putting it on display on a school wall, or on a school website) offers a provocation, or invitation, to students, educators and parents alike, to think and enquire further through various lenses. What would happen if ...? I wonder how ...? The learning story is impacted by the choice of photos, by the text that is selected, and by the voice that is present (or absent).

“Although the visual displays have the effect of beautifying the environment, their true intention is to open a window onto the work and thought processes of the learners” (both children and adults). (Campbell, Brownlee, & Renton, 2016, p. 2)

Through the process of pedagogical documentation, and the creation of learning stories, educators are researchers alongside the students. “Learning stories are the way we can all do research and create communities of practice that help us grow as teachers and as human beings”. (Carter, 2010, p. 40) Learning stories attend to student thinking; they have the capacity to support and record student agency in the EE learning journey.
3. The E4E project

As EE researcher/practitioners at a Faculty of Education in Ontario, Canada, our experience with the utility of learning stories in assisting students to steer the path of their own learning, was grounded in a three-year collaboration project we called E4E (Educating for Environment). We concur with the recommendations of the Acting Today: Shaping Tomorrow policy (OME, 2009), and believe that EE should not be viewed as a single event like a yearly field trip, but should be part of ongoing learning (and teaching) and viewed as a normalized component of the curriculum and learning process. However, our experience in schools was that this intention was not generally borne out and that if EE was introduced, it was often at an Outdoor Education centre on a limited basis. Often the educator(s) supervised the students while a facilitator(s) at the centre provided instruction and activities.

To further explore the idea of embedded and integrated EE, we partnered with a local school board, and each spring, over three consecutive years, with three very different community public schools’ explored methods to embed and integrate EE across the formal curriculum. Teams of school educators, and freshly graduated teacher candidates, hired as E4E facilitators, collaborated and co-planned the design and implementation of learning opportunities in response to the students’ interests, and the requirements of curriculum. The educators and facilitators were supported by a school board program coordinator, and by us, the researchers/practitioners; the partnership created opportunity to explore learning from both pre-service and in-service perspectives.

Facilitators and educators together integrated outdoor environmental thinking in authentic ways with subjects such as math, language, science and social studies, while ensuring an inquiry-based process for students and fostering a collaborative inquiry stance for facilitators and educators. In the context of the E4E project, student inquiry was frequently aligned with the elements of self-determination theory—that is: feelings of competence, opportunities for choice, and a sense of belonging (Darner, 2009; Deci & Ryan, 2012). Examples of student inquiry included: grade five students curious about how to quantify the speed of a stream-flow using floating objects (e.g. ping pong ball and a stopwatch), through which mathematics concepts, skills and processes were uncovered; groups of grade six students exploring survival and how it felt to create shelters using found materials in a forested area, which enabled them to experience the history of early settlers and First Nations curriculum; and, grade five students finding their voice through the writing and sharing of advocacy letters for the environment, and understanding the impact of persuasive writing as essential to the language curriculum. In addition and with intentionality, learners went on exploratory hikes during which they were encouraged to question, explore and record their thinking using devices such as an iPads or phones. Ponds, logs, plants, rocks—all held a natural fascination for learners. Their purpose was not to “get answers”, but rather to continually ask deeper questions. Games such as Camouflage (in which students had to blend into their surroundings to avoid being “caught”), or Oh Deer! (Project WILD, 1992) (demonstrates basic principles of population density) were chosen with an eye to curricular requirements and inquiry opportunities, and when played often elicited smiles and shrieks of delight—audible and visual signs of whole—self engagement. Creating art in nature using found materials in the outdoors provided an outlet for students to consider their surroundings through different eyes, to expand their imaginations, to focus on elements of design in nature, and how each “spoke to them” aesthetically. Following the learning opportunities, students were given time for personal reflection and writing in their journals, often in a quiet sit-spot in nature. Facilitators and teachers encouraged students to pursue their thinking in directions that mattered to them. The resonating impact was that thinking was emphasized, and curiosity drove the next steps in the inquiry.

3.1. The evidence

As part of the larger E4E research project, we report here on our evolving understanding and use of learning stories as windows into EE thinking and learning. We refer to the learning stories that were created during the second two years of the three-year project and consider these as data because, by their nature and definition, they can illustrate/illuminate/reveal/expose what students are prioritizing, and how they are thinking. Learning stories breathe life into learning and how it looks, sounds and feels.
The learning stories from the E4E project can be divided into two groups: (a) picture-only collages that were created by primary/Early Learning Kindergarten [ELK] students and their educator(s) making individual thinking visible through choice of photos; and (b) text and picture posters (reflective of the pedagogical documentation model) that were designed by facilitators. In both cases, the relevant evidence comprises students making choices, taking ownership, and having agency over their learning.

3.2. ELK Visual photo collages
The ELK picture-only learning story collages were created in the following way: during a “Nature Hike”, the ELK educator assisted one student at a time to take a portrait on an iPad or cell phone (a small device for small hands) which would provide identification to their series of pictures. Each student was tasked to take pictures of objects/ideas in nature about which they were curious/amazed/intrigued; after several minutes the recording device was passed to the next student. Using an app, the ELK educator then designed picture collages with each student, showing their selfie and the photos that they had taken (Figure 1), followed by conversations in the classroom about the ideas presented (i.e. Why did the student take those particular photos? What did they find intriguing about a particular picture? What did they learn about?). The collages were then displayed in the classroom and hallway, and sent home to spark conversations that revealed the thinking pathways of each of the students. Missing from our data are transcriptions of student and educator voices as they analyse their E4E learning experiences, but this encouraged us to sharpen our interpretations of nonverbal/text communication. It also illuminated the importance of listening for and documenting narratives of thinking and learning to deepen pedagogical understandings (pedagogical listening), sharpening learning intentions, and lifting professional curiosities.

3.3. Picture-text posters
The picture-text learning story posters were created by the E4E facilitators, who each year were composed of a newly graduated group of educators. During the various E4E learning experiences, the facilitators themselves were invited to take a listening and inquiry stance by collecting photos,
videos and audio recordings (that were transcribed) and written comments, as a way to document student thinking. The facilitators then used the photos, transcribed text, and written comments to produce a document that highlighted the learning processes, not only of the students, but also their own. For example, the poster in Figure 2: summarizes the actual learning undertaken during a day on the university campus (Aboriginal and Early Explorer Relationships and Using the Natural Environment as a Creative Outlet) while: providing opportunity for facilitators to express their growing understanding of their roles; inviting viewers to listen to the thinking of the students during the learning process; and, providing visual information that supports the text.

Figure 2. Picture–text poster.

Grad 4/5

Thoughts From the Facilitators

Throughout the fur trade game, the students were actively engaged in taking on their roles of Aboriginal people and early explorers. The students critically thought about what was needed to survive and what they should trade for.

During their sketching period in the forest it was really amazing to see all these active, energetic students become calm and peaceful in their surroundings. The Forest was incredibly quiet and the atmosphere really transformed the students.

Day 2: The Fur Trade Game and Art in Nature

In Social Studies, the Grade 4/5's were learning about Canada's First Nations and Early European Explorers. The students played a fur trade game in order to discover the relationship between these two societies. This game had the students exploring the forest to find "aboriginal encampments." At each station the groups gathered knowledge about these societies and their environment. They then traded their information for beaver pelts, and later exchanged their pelts for tools and resources. The game was followed by a knowledge-circle in which we discussed strategies and addressed any inquiries we had during our trading experience.

In the afternoon the students researched Andy Goldsworthy - a site specific land artist who uses the natural environment and materials to create his works of art. The students were then given time to create their own pieces of artwork using the natural environment and found natural materials. Their final pieces were fantastic, each creatively integrated nature with the elements and principals of design. Art and nature inspired, we finished our day with each student finding their own quiet spot in the forest to sit and sketch.
4. Analysis and discussion
The E4E project effectively uses EE as a venue to (among other things) foster student-focused learning. In the previous section we described the work of the teachers and facilitators in designing and implementing learning opportunities for students, and reported the data depicting student learning. In this section, we connect teacher practice with student outcomes. Indeed, it is difficult to consider one without the other, since teacher practice and student outcomes are so closely connected that, in this project, we see them as two sides of the same coin; the emphasis in the paper merges the two.

The images and transcripts depicting E4E learning stories illustrate a number of different ways in which students take ownership of their learning. We employed the transcripts, visual images and
learning stories from the second and third of the three years of the project, as our data. The first year of the project did not focus on learning stories, nor on student voice, since we were just beginning to understand the concepts as they might relate to the E4E project. The partnering of teachers and facilitators with a wide range of experience sparked the opportunity to examine pedagogical shifts in education.

With respect to the relevant data, we took a grounded theory approach in our analysis, since grounded theory data ideally consists of interview data, field data, and categorized information (Cresswell, 1998), all elements that closely aligned with our data. Moreover, Cresswell (1998) suggests the use of grounded theory when searching for a theory that relates to a particular situation or context being studied, that is, to “create theoretical categories directly ‘grounded’ in the data” (Charmaz, 2008, p. 82), which is the situation in which we found ourselves. Grounded theory is a multi-modal data analysis methodology that is comparative and inductive, whereby the researcher(s) find patterns arising from the data; grounded theory analysis is reflexive in that it “keeps you interacting with the data and your emerging ideas about it” (ibid).

4.1. Analysis
Upon careful (re)reading and (re)consideration of the transcripts, and reviews of the photos, our application of a grounded theory analysis lead us to propose five learning pathways that students might apply as they theorize about their world in an integrated inquiry-based EE experience.

Below, we present five examples of learning pathways: the reasoning pathway, in which students articulate the process of specific thinking as it relates to their learning (e.g. I am noticing this, so it is making me think that …); the propositional pathway whereby students (or educators) ask questions and explore plausible outcomes (e.g. I see and hear this, and am curious to know what would happen if …); the action-oriented pathway, in which students suggest a course of action based on their learning experiences; the metacognitive pathway through which students demonstrate an awareness of and articulate their thinking; and, the emotive pathway in which students respond emotionally to their experiences. We provide samples from the photos and transcripts to demonstrate each of the five pathways.

4.1.1. Reasoning pathway
The reasoning pathway demonstrates student rationality, or sequential logic, in relation to a specific learning experience. Students explain how they arrived at a particular conclusion (Figure 3).

I know that those are Trout Lilies because they look like the fish.
I thought the axe was the best item to trade for because you could hunt animals with it and make clothing, and cut down wood to make a shelter.
It feels like a maple tree, the bark feels clumpy and rocky and almost smooth.

Figure 3. “The bark feels ...”.
4.1.2. Propositional pathway
The propositional pathway comprises questioning and speculation. Questions might be asked by the students themselves, or by the facilitator as a way to provoke thinking (Figure 4).

I found holes, maybe made by mice? But they are big, maybe a rat? There are lots of them, they must be connected.
Birch bark is a healer in tea. Maybe it could heal the water?
Educator: What did you predict would happen?
Student: That all of the layers were going to take in all of the chemicals. The moss, soil, sand, and rocks were going to soak it up.
Educator: How did you know that? Tell us more about what caused you to think this way.
Student: When we did the water filters last week at Nipissing, my partner and me used the same materials and it cleaned the dirty water into clean water.
Educator: What did you notice about each natural material? (leaves the reader as well as the students in an inquiry stance).

4.1.3. Action-oriented pathway
On the action-oriented pathway the student suggests a course of action based on the learning experience (Figure 5).

Let’s make an assembly line to get across the stream without spilling our water.
If we use these sticks with the Y at the end they can hold up the wall.
We could get bark that rolls up so that it curls around the branches to keep the rain out.

Figure 4. “When we did the water filters last week ...”.

Figure 5. “If we use these sticks ...”.

4.1.4. Metacognitive pathway
The metacognitive pathway provides a window onto the landscape of student metacognition whereby students communicate an awareness and understanding of their own thought processes (Figure 6).

The hardest part of this is trying to figure out what activity is more important to me. I have never had to do that before.
I haven’t decided yet, there are a lot of nice things to choose from. I’m just going to sit here and look at the pond until I decide.

4.1.5. Emotive pathway
The emotive pathway encompasses the student’s affective response to a learning experience; the student recognizes and articulates their emotions, whether positive or negative (Figure 7).

This is so beautiful and peaceful.
I love the smell out here instead of the classroom. I love to breathe this fresh air.
The Forest was incredibly quiet and the atmosphere really transformed the students.

4.2. Discussion
As discussed earlier, EE was the vehicle by which we were able to explore the concepts of pedagogical documentation in the form of learning stories. The inquiry-based pedagogies offered via EE, including significant time exploring topics in the outdoors (as opposed to the limited space and resources afforded by an indoor classroom), evoked rich and diverse learning experiences, and ignited meaningful questions that mattered to the learners. The experiences of the learners resonate with elements of self-determination, particularly the opportunities for choice, and the sense of belonging to and respect from peers (Darner, 2014; Deci & Ryan, 2012). Learner responses to their experiences, as they were observed and recorded, connected us to inner pathways of thinking and learning; these are further examined below.
4.2.1. Learning pathways

The first three pathways, reasoning, propositional, and action-oriented should be familiar to most educators. Students are often asked to explain their thinking in logical sequences, to answer questions, and to propose and then take action centred on a topic. We were not surprised to see these three pathways emerge from the data, since these are forms of thinking, learning, and acting to which students are accustomed, and which we would expect them to feel comfortable articulating.

We were delighted to find the fourth and fifth pathways in the data, as these are not (yet) as common in teaching/learning opportunities. Student statements in the metacognitive pathway confirm that the student is thinking about their thinking—they are aware and mindful of their progress and process in the learning experience. Similarly, the emergence of the emotive pathway confirms what most educators know intuitively, that emotions are an integral component of learning. Research confirms that emotion is important to learning because it focuses attention and underlies memory (McGeehan, 2001; Pert, 1997; Sylvester, 1995). The learning story is a platform that values and gives permission for the affective dimension of learning to be articulated and valued along with the cognitive dimension. It recognizes and gives voice to this dimension of human development. It promotes a healthier, holistic and balanced lens on learning.

4.2.2. Who tells learning stories and what might they look like in the future?

The process of documentation originated in primary school settings as a way to capture the holistic growth and development of the young student through observation. The educator was solely responsible for collecting and interpreting observations. In today's context, with the possibilities of twenty-first-century innovative technology, it begs us to think about the possibility of learners documenting and/or contributing to the documentation of their own learning. Indeed, we witnessed examples of the move from educator as observer/documenter, to students sharing this responsibility. Students as well as educators can use video to record inquiries, emotional responses, and the ‘aha’ moments of knowledge and skill acquisition and human wonderment. Evidence from the metacognitive pathway tells us that students are capable of thinking about, and interpreting their own learning. It promotes student voice and ownership of learning. Self-determination theory suggests that students are capable of telling their own learning stories, and will benefit from doing so in terms of developing their sense of competence and respectful sharing (Assor, Kaplan, & Roth, 2002; Darner, 2009, 2014; Deci & Ryan, 2012; Reeve et al., 2004) The practice of documenting to tell stories of learning, aligns many perspectives, and invites us to share a more comprehensive lens on learning. Who knows the possibilities when students themselves take greater ownership of their learning, and share in the interpretation thereof?

Further, as we make use of new technologies, we also change how we interact with the outdoors; rather than collect “samples”, students can take photos of specimens for later study, collect sounds from their soundscapes including bird calls or chatter from squirrels, or record visual imagery to be utilized in reporting their discoveries. The indoor/outdoor divide in EE may need to be reimagined knowing that we (students and educators) increasingly experience the world through digital media, and realizing the urgency to promote active, experiential learning in the community to develop healthy, optimal habits for life.

4.2.3. Critique of the E4E learning stories

We recognize that our use of learning stories was not without shortcomings, inasmuch as we did not, in the scope of the E4E project, achieve what we have described as the ideal in Section 2.3. How Learning Stories are Used. Students were encouraged by teachers and facilitators to wonder, question and articulate their thinking, however, within a number of constraints. For example, available resources both indoors and outdoors limited the direction and scope of student choice in what topics they wished to pursue. The very premise of the E4E project, to embed EE in curriculum, defined the general topics that would be studied, such as Early Settlers and First Nations, or mathematics and language skills. Thus, we cannot claim that students had complete autonomy in their choices, though efforts were made to provide significant choice within those topics.
The required practice of teachers and facilitators, in listening, observing, recording data and then creating visual documentations (Turner & Wilson, 2010; Wien, 2011, 2013) was in its infancy in our context. The facilitators commented on how difficult it was to facilitate learning experiences for students, and at the same time attend to individual students to observe and record their learning pathways. The facilitators eventually assigned themselves the two roles, such that by working in teams, they could accomplish both tasks with some degree of success. In addition, the practice of having students discuss the various learning stories as a way to reflect further on topics was not achieved in any significant way of which we are aware. (This may have been done by individual teachers with their classes after the project ended). We lacked both time and skill/experience to pursue this avenue of the research, but we see it as an important next step in understanding how learning stories can impact student outcomes.

Since teacher practice lies at the heart of students’ sense of agency (Assor et al., 2002; Darner, 2009, 2014; Reeve et al., 2004) evidence that their work in the E4E project impacted teachers’ professional learnings, curricula and practice should be highlighted in our report. Sadly, formal evidence is lacking in this regard; we have not extended the project to the point where we have investigated significant change in teacher/facilitator practice outside of the project. Our understanding of changes in teacher practice is largely anecdotal and informal; we listened as facilitators and teachers discussed individual students’ work and communications, and posited ways to guide and facilitate deeper understandings. This suggests to us that teachers and facilitators were accommodating their practice based on student learning. Again, we recognize this direction of research as critical to our larger understandings of the underlying and far-reaching influences of the use of learning stories.

4.2.4. Limitations of learning stories

All new pedagogical initiatives in education, regardless of their appeal, demand a critical eye by practitioners, and the use of learning stories in EE is no exception. Concerns might arise around the subjectivity of the documentation process when the educator is also the documenter: Are they only seeing the learning process through their own lens rather than empathizing through the lens of the student? Can biases be identified and understood through the self-reflective process? Indeed, can an educator adequately document the learning, and create individual learning stories for all of their students, with equal attention and understanding of their individual learning pathways? Do learning stories really tell the whole story of learning? We think it unlikely. Yet, we take Jickling’s (2009) view that narratives about learning provide educators with additional information, depth, and detail about a student’s learning pathway. As such, learning stories become part of the larger picture of assessment for the purpose of understanding students, and of continuing to facilitate their learning pathways.

A second cautionary note is in regard to the use of photographs (of students at work) that will likely be displayed publicly (either in the school or on a website). While school boards have strict policies and procedures governing parental consent of the creation and use of student photos, nonetheless, it should be understood that the photos (and text attributed to specific individuals) may be revisited over time to (re)explore patterns and trends in learning. This moves ethical considerations of personal/family privacy from the present into the future.

5. Conclusions

Our work with the E4E project has demonstrated that teacher practice in the use of learning stories, as EE is embedded in curriculum, has considerable impact on the level and quality of opportunities of student agency, as evidenced by their deep engagement.

We take the position that EE, in its many forms, or currents (Sauvé, 2005), both indoors and outdoors, must be a vital and essential part of education for all students. It has an impact on trajectories for learning, attitudes about self in the context of others and world, and overall health and wellness. The E4E project was a deliberate endeavour to embed EE content and pedagogies within formal elementary curriculum as a way to integrate multi-subject learning about the environment, in the environment and for the environment. An outgrowth of the E4E project was the use of learning
stories as a means to document the learning opportunities and experiences of the students, facilitators, educators, and researchers; in this report we focus particularly on students as they followed their chosen pathways of inquiry. We found learning stories to be particularly useful in capturing the EE integrated experiences, identifying elements of student agency, and supporting the consequent emergent thinking of those involved in the learning experiences.

The five learning pathways that emerged from our work, *reasoning*, *propositional*, *action-oriented*, *metacognitive* and *emotive*, provide insight into the thinking and learning enacted by students during student-inquiry-based learning opportunities. While the first three pathways are likely to be recognized by educators in formal classroom settings, the last two, the *metacognitive* and *emotive* pathways, are less commonly elicited during formal teaching and learning, yet are important in understanding and supporting students during their learning journeys. The list of pathways provided here need certainly not be limited to five, and we expect that additional research in this area will identify additional pathways in student thinking and learning.

Darner (2009) recommends research in how to support self-determination in the EE classroom and learning stories may be the appropriate avenue. Our work in the E4E project has demonstrated that EE as the vehicle for alternative pedagogy, and learning stories as the windows to understanding/assessing the individual EE learning experiences, are a useful combination that: (a) foster a student-inquiry approach; (b) put considerable agency for learning into the hands of students; (c) promote a refinement of the learning/teaching relationship between student and educator; and (d) support documentation, by educator and/or student, to capture the complex nature of learning that goes far beyond content acquisition.

As a result of the E4E project, we became familiar, and increased our facility, with learning stories as narratives that documented the learners engaged in moments of learning; moments of curiosity, struggle and engagement, that could be interpreted, analysed and reflected upon. The uncertainty that educators might feel, as students engage on a learning pathway of their own choosing, is mitigated by the learning story process. Educators become provocateurs, challenging the thinking of their students, and of themselves. The practice of documentation and the co-creation of learning stories encouraged individual and collaborative reflection: we were challenged to consider what happens when we approached student learning pathways with sharpened awareness. We have a great deal more to learn from our students—and recognize that we must journey alongside them. As co-researchers in a collaborative inquiry we remain curious and open to wonder on the learning landscape.

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