Environmental and Sustainability Education Pedagogical Approaches in Pre-service Teacher Education

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Abstract

This qualitative case study examines the effectiveness of environmental and sustainability education (ESE) pedagogical strategies used in two Université de Saint-Boniface pre-service teacher education Curriculum and Instruction courses. The methods used to teach these ESE pedagogical strategies are described. Findings from interviews with former students regarding their perspectives on the effectiveness of these strategies and how they are applying similar strategies in their teaching are presented. Findings suggest that these ESE pedagogical strategies are effective. Questions about efficacy of these strategies, the limitations of their implementation, and the study itself are reflected upon. This study contributes to Evans et al.'s (2017) call for empirical research into the effectiveness of ESE pedagogies and a critical reflection of such research by the researchers.

Résumé

La présente étude de cas qualitative examine l'efficacité des stratégies pédagogiques employées en éducation à l'environnement et au développement durable dans deux cours en enseignement et programmes d'études offerts aux étudiants en enseignement de l'Université de Saint-Boniface. L'article décrit la manière dont ces stratégies pédagogiques sont enseignées et présente les conclusions des entrevues réalisées auprès d'anciens étudiants dans le but de recueillir leurs points de vue sur l'efficacité de ces stratégies et la manière dont ils les appliquent dans leur pratique. Selon les observations effectuées, ces stratégies pédagogiques d'éducation à l'environnement et au développement durable semblent efficaces. L'efficacité et les limites de la mise en œuvre de ces stratégies, de même que l'étude en tant que telle, font également l'objet de réflexions. La présente démarche s'inscrit à la suite des travaux d'Evans et collaborateurs (2017) sur la nécessité de mener des recherches empiriques pour évaluer l'efficacité des stratégies pédagogiques d'éducation à l'environnement et au développement durable et pour poser un regard critique sur le travail des chercheurs dans ce domaine.

Keywords: education for sustainability in faculties of education, pre-service teacher education, ESE in higher education

Mots-clés : éducation au développement durable dans les facultés d'éducation, formation des enseignants, éducation à l'environnement et au développement durable dans l'enseignement universitaire

Environmental and Sustainability Education Pedagogical Approaches in Pre-service Teacher Education

Environmental and sustainability education (ESE) emphasizes social and environmental well-being. It helps students develop knowledge, attitudes, and values so that they can become responsible, active citizens that contribute to a sustainable future (Inwood & Jagger, 2014; O'Brien, 2016). As stated by Block, Sims and Beeman (2016), "[T]eacher education can be instrumental in developing values and practices so that teacher candidates may develop pedagogical approaches that support a transition towards sustainability (UNECE, 2012)" (p. 128). ESE is influenced by various learning traditions that share a belief in promoting a more sustainable and equitable world for all living beings on this planet, such as environmental education, sustainability education, eco-justice education, Indigenous education, and peace education, among others (Anderson, Chiarotto, & Comay, 2018; Karrow, DiGiuseppe, Elliot, Gwekwerere, & Inwood, 2016).

In 2017, Evans, Stevenson, Lasen, Ferreira, and Davis wrote that though sustainability may be mandated within school curricula, ESE is not a mandated component of pre-service teacher education in most countries. Their recent literature review on programmatic approaches finds that:

> There are four key approaches used to embed SE [sustainability education] in pre-service teacher education: (1) across whole curriculum areas, courses or an institution; (2) through dedicated core/compulsory subjects; (3) a component of a core/compulsory subject; or (4) a dedicated elective subject. (p. 411)

In terms of pedagogical strategies used to embed ESE into pre-service teacher education, Evans et al. (2017) identify: "place-based, experiential and/or inquiry methods, and modelling strategies for teaching SE that student teachers can apply in schools" (p. 412). These pedagogical strategies include: "discussion and reflection techniques . . . ; brainstorming . . . ; concept mapping . . . ; place-based outdoor experiences such as field investigations/inquiries or projects . . . ; values analysis; role plays . . . ; problem-based inquiries . . . and problem solving activities" (p. 412). Despite these programmatic and pedagogical strategies used to embed ESE in pre-service teacher education, the reviewers critically note that while "authors report the use of a diverse range of pedagogical strategies . . . they offer little or no critical reflection upon, or evaluation of, these strategies and approaches in terms of their effectiveness in developing the knowledge, skills, values and dispositions required to implement SE" (pp. 413–414). It is this particular finding that provides an important motivation for our research.

Purpose of the Study

Evans et al. (2017) identify a need for empirical research that evaluates the effectiveness of ESE pedagogical strategies used in pre-service teacher education

programs, as well as a critical reflection on this research. To address these needs, our case study examines and critically reflects on the effectiveness of various ESE pedagogical strategies used in two Curriculum and Instruction (C&I) courses in the pre-service teacher education program at the Université de St. Boniface in Manitoba. The study's specific research questions are: i) What are former students' perspectives on the ESE pedagogical strategies used in these courses? and ii) What are their experiences incorporating these strategies in their classroom teaching? These research questions address Evans et al.'s (2017) effectiveness challenge. In the discussion section of this paper, we will address the critical reflection challenge that Evans et al. pose.

ESE Pedagogical Strategies Used in the Pre-service Teacher Education Program

As part of their pre-service teacher education program, study participants had taken curriculum and instruction (C&I) courses in their teachable subjects. Some had taken the C&I Social Studies (Secondary) course (taught by Sims), while others had taken C&I Science (Elementary, Secondary) courses (taught by Asselin). In the following section, we describe the ESE pedagogical strategies that have been used in these courses for the last five years.

The C&I Social Studies (Secondary) Course

In this course, ESE pedagogical strategies are organized into two major assignments intended to model and explicitly teach these strategies to students.[1] Initially, the focus is on using community-based teaching strategies: walking about the neighbourhood as well as brainstorming not only how community, environmental spaces can serve as settings for learning but also how these proposed ideas relate to curricular expectations. For the first assignment, students teach a curriculum-related lesson that integrates local community-as-classroom (Block et al., 2016; Sims & Falkenberg, 2013). Following the lesson, all students analyze how the lesson's activities reflect key ESE strategies as outlined by Kozak and Elliot (2011): learning locally; being integrated and making real-world connections; considering alternative perspectives; learning inquiry-based strategies; providing opportunities to act on learning; and sharing responsibility for learning with students. We discuss how their proposed activities could be adapted to other situations. We also visit educational community-based resources/sites of their choice (e.g., Manitoba Museum) to learn about programs offered at those sites.

The second assignment focusses on engaging students in inquiry-based strategies (Chiarotto, 2011). We use strategic planning and essential questions[2] (Wiggins & McTighe, 2005) to guide learning. To develop skills related to facilitating inquiry-based learning, students are taught how to generate and refine

critical questions and then how to do research with pupils. Specifically, students must plan a curricular unit: they must propose learning-focussed activities that allow for students to explore essential questions coherently and must provide opportunities for meaningful experiences, inquiry-based activities, and opportunities to act upon learning. As part of this process, students must outline how they would facilitate an inquiry-based research process that would be guided by their pupils' questions. Throughout this process, students are invited to connect curriculum to real-world environmental and sustainability issues.

The C&I Science (Elementary and Secondary) Courses

In the C&I Science (elementary and secondary) courses, ESE pedagogical strategies are explicitly taught, and students are asked to practice them. Students learn to use their community and environment as a context and source for experiential learning by participating in field trips. The focus in these courses is on learning why, how, and when it is appropriate and valuable to use field trips for science learning. Experiential learning through scientific experiments is used to enhance students' scientific literacy, curiosity, and engagement. When they are linked to an inquiry process and when real-world connections to multi-faceted science-technology-society-environment issues are made, these experiential learning strategies provide students with opportunities to ask questions and try to find answers in the laboratory and environment (Manitoba Education, Citizenship and Youth, 2006).

Methodology and Methods

This study used an embedded, single-case design with the two courses as the two units of analysis within the single case (Yin, 2009). A purposeful sampling procedure was used to identify study participants. To provide a broad range of perspectives, we invited former students who had taken at least one of the above-described courses within the last five years and who are now teaching in the Manitoba school system. In total, 17 former students participated. Of these, 8 had taken the Social Studies course, 6 had taken the secondary Science course, and 3 had taken the elementary science course. Of the 17 participants, 4 are teaching in their first year, 6 are teaching in their second year, 3 are teaching in their third year, 1 is teaching in their fourth year, and 3 are teaching in their fifth year. Of all participants, 3 have taught (or are currently teaching) early years (Grades K–4), 5 have taught middle years (Grades 5–9), and 10 have taught in senior years (Grades 10–12).

The participants were interviewed in French, in person or by phone, between November 2017 and February 2018, using semi-structured interviews. Organized according to the two research questions, interview questions were tailored to the different C&I courses to explore specific ESE pedagogical

strategies: i) facilitating community-based strategies; ii) encouraging inquiry-based learning and making real-world connections; iii) applying and acting on learning; and iv) sharing responsibility for learning with students. Interviews were transcribed for later analysis.

Data analysis consisted of coding and interpretation processes (Cohen, Manion, & Morrison, 2018). Initially, data was analyzed for evidence of emergent themes. Then, each interview was coded according to these identified themes. Larger domains of analysis were framed by the two research questions. Atlas-ti, a qualitative data analysis software program, was used to select and code data segments, create memos, and build families of codes based on the themes that emerged from the data.

Results

The results section describes research participants' perspectives on specific ESE pedagogical strategies that are used in the C&I courses. This is followed by an exploration of the degree to which participants have applied similar strategies in their own teaching. The results are organized around dominant themes that emerged when analyzing the data. However, participants' quotations are rich texts, often inclusive of various themes. These quotations represent majority viewpoints unless otherwise indicated. Upon participant request, real names were used unless otherwise stated. Participant quotations were translated from French by the authors.

Participants' Perspectives on the ESE Pedagogical Strategies Used in the C&I Courses

When analyzing results, it quickly became apparent that participants were most interested in sharing their perspectives on the community-based, experiential, and inquiry-based strategies used in the courses. These experiences were the most memorable for them and the most transformative in their perceptions of possibility in their practice. Honouring their experiences, results are organized as follows: i) perspectives on learning community-based strategies; ii) perspectives on inquiry-based learning and making real-world connections; and iii) general recommendations for the C&I courses.

Learning community-based strategies. A major focus in the C&I Social Studies course is to experientially teach—and have students practice with each other—how to meaningfully integrate the local community into learning experiences. Significantly, seven of the eight participants stated that this approach was new to them, one said she learned it from her cooperating teacher (a former Social Studies C&I student), and four stated that this was the first time they had gone outside of the conventional classroom to learn.

Seven participants from the C&I Social Studies course remarked that this kind of pedagogical approach had to be lived to be conceived, that is, that they needed it modelled in order to imagine it for their teaching situations. For example:

> We have to live it . . . we're not going to know how to do it with our pupils if we just learn it theoretically. If we hadn't actually gone outside, I never would've thought of doing something outside. It allowed us to think about the possibilities we have. (Stephany)

Natasha revealed how these C&I activities taught her a theoretical and practical structure for integrating her pedagogical practice with the community:

> Learning how to teach in the community helped me understand how young people can relate/build relationship with people in the community, either people coming into the classroom or kids going to the community. . . . You just have to show kids how to do it. Without this course, I wouldn't have known how to do it. (Natasha)

Six participants stated that this enlarged, or transformed, their concept of what "teaching" means. For instance:

> I discovered the possibility and importance of getting outside the classroom . . . it was very interesting, engaging. The projects made me realize that there are different possible approaches with which one can play. . . . The course enabled us to get out of the classical vision with which we've been taught. . . . It's a method you have to learn, for which you have to have some permission to practice. . . . It gives us the courage to try, it opens our eyes to what is possible: we must see an example to follow it. (Meghan)

Interestingly, this sentiment of needing courage or permission to teach in this non-conventional way was echoed by five of the seventeen participants.

With respect to learning *how* to use community-as-classroom, all eight participants from the C&I Social Studies course stated that having this strategy modelled and then creating and experiencing others' activities enabled them to learn, or deepen, their understanding of this concept. Imagining how to adapt these activities for different contexts and levels was useful for many participants. Learning the appropriate administrative steps to take pupils outside (e.g., the permission process needed to leave school grounds) was identified by one participant as useful.

In the C&I Science courses, as in C&I Social Studies, field trips to educational sites (e.g., FortWhyte Alive, St. Boniface Hospital Biolab) are used to learn how these kinds of resources could be employed to enrich and often contextualize students' teaching of (scientific) concepts. All nine participants from the C&I Science courses stated that visiting these sites and experiencing the programming offered made it easier to use these resources and others like them in their teaching. For example:

We visited FortWhyte, I saw everything that they offered. It's easier as a teacher afterwards because you're already familiar with the site and programs, you take fewer risks. (Annick)

Overall, all participants from the C&I Science courses felt it was valuable to see examples of what a field trip might be for different subject areas. One participant commented on the value of experiencing what their pupils would experience. All seventeen participants highlighted these field trips and community experiences as very memorable and engaging.

Inviting guest speakers is another way to integrate the community into classrooms. Examples of what this might look like when teaching Social Studies and Science are explored in the C&I courses. Certainly, participants would have experienced this through previous education courses, notably when discussing sensitive and complex issues in courses (e.g., colonization and its impacts, LGBTQ issues). In having been exposed to alternative, authentic, informed perspectives, participants, particularly those teaching middle and senior years, commented that they learned the value of, and need for, hearing various perspectives when facing complex issues. They recognized that providing similar opportunities was important for developing critical thinking skills in their pupils.

Inquiry-based learning and making real-world connections. In the C&I Social Studies course, teaching inquiry-based strategies focus on developing critical thinking and research skills and are accompanied by learning to plan, guided by curricular outcomes as framed by essential questions.

Participants said that learning how to explore topics in this broad, integrated way was valuable as it helped them be more organized in facilitating learning that was guided by pupils' questions. For example:

The C&I course made me better at grouping things together, organizing objectives into different steps. . . . The project we did led me to understand that it's not just the teacher giving material and pupils creating something from it, but rather getting pupils to look for their own answers. We must be facilitators as much as teachers. (Rachèle)

All participants, to different degrees, recognized that providing opportunities for inquiry-based activities engaged their pupils meaningfully in the learning process. Participants commented that bringing in a Social Studies teacher "from the trenches" to share how she facilitates an inquiry process with her pupils was worthwhile.

In the C&I Social Studies course, part of sharing the responsibility for learning involves students taking leadership roles, teaching each other, and sharing resources. A key aspect of this inquiry-based, focussed planning assignment is having students share and analyze each others' proposed plans.

In the C&I Science courses, Asselin approaches the inquiry process in a few ways. First, at a broad level, in the secondary-level course, she discusses how to integrate research on science-technology-society-environment issues into students' teaching. For example, she explores with the students the importance

of developing a scientific culture with their pupils, so that one day, as citizens, the pupils can make informed decisions about various subjects. Asselin suggests age-appropriate ways to guide learning so that pupils can ask critical questions and explore research topics related to pressing socio-scientific issues, such as climate change, environmental conservation, and health. When queried, all of the participants in the C&I Science courses recommended that she continue conceptualizing science learning within broader societal issues as they found this to be an important part of their learning experience. Of the seventeen participants, four commented that, time permitting, the learning of this concept could be further enriched if students were to receive even more concrete examples and if they were to be given a course assignment based on it.

Second, doing experiential learning activities (e.g., experiments, dissections, demonstrations) in the courses shows students how hands-on activities can help their pupils' understanding of scientific concepts and can contribute to scientific curiosity. All participants from the C&I Science courses commented that they found it very useful to plan, prepare, and share an experiment with their class colleagues as it made them more confident and gave them practical ideas and resources that they now use in their teaching. For instance:

> Having to prepare an experiment . . . seeing that I'm able to do research, finding something that works . . . that was encouraging. I think that actually experiencing/living the demonstrations, others' experiments, reinforces the value of experiments. (Jaclyn)

General recommendations for the C&I courses. General recommendations by participants were to continue teaching in this aforementioned way and to make sure to: i) explicitly stress the importance of ESE, reminding students that we educate within the larger context of creating responsible citizens; ii) give many practical examples and resources; and iii) explore how to adapt these strategies for different age groups and environments (urban, rural).

Overall, all seventeen participants found that the ESE pedagogical strategies taught in the C&I courses have been worthwhile for them. In what follows, examples of how these former C&I students are integrating these ESE strategies into their teaching practices are shared.

Participants' Experiences Incorporating These ESE Pedagogical Strategies Within Their Teaching

When participants were queried as to how they are using these ESE pedagogical strategies in their teaching practices, their examples show that they are integrating these strategies in various ways. Reflecting themes that emerged during data analysis, results are organized as follows: i) examples of community-based learning, providing opportunities to act; ii) facilitating experiential, inquiry-based learning; iii) importance of relationships; iv) sharing the responsibility of

learning with pupils; and v) constraints or challenges to integrating ESE peda-gogical strategies.

Community-based learning, providing opportunities to act. Participants are using their local natural and built environment and community as learning contexts in various ways in Social Studies, Science, and other classes. All participants shared how they take pupils outside to learn. Examples of participants using specific locations and events to explore topics include:

Social Studies (high school):
- Walking to school division's outdoor classroom, settling into the tipi, making a fire, preparing bannock. "The pupils loved it! They saw a real tipi after learning in class how to build one" (Meghan).
- Going to St. Boniface archives to study primary sources.
- Going to Brookside Military Cemetery where "we were greeted by five vet-erans. . . . The kids wanted to continue talking to them, it was concrete, human" (Meghan).

Science:
- Going to Planetarium, Science Gallery. "The kids were so invested. We've lots of newcomers, it's so amazing to see their faces, kids who've never done something like that before" (Janelle; Grade 2).
- Retrieving samples for testing from the outdoors. "At Oak Hammock Marsh we took water samples to see the different organisms. . . . In the lab, we did lots of tests: pH, oxygen content . . . : it was really cool. In the afternoon, we snowshoed/hiked to observe different animal tracks" (Kelsey; Grade 10 Ecology).

Math (high school):
- Visiting FortWhyte to measure trees using trigonometry.
- Creative planning. Stephen plans to create an escape room to promote crit-ical thinking, group work.

Work-life (high school):
- Going to the mall to explore different jobs: "each place welcomed us with open arms . . . the pupils really enjoyed it" (Phil).

Media Studies (high school):
- In Stephany's class, walking around their Francophone town to look at types of advertising, languages used (English/French). In December, going to Operation Red Nose (bilingual) press conference before beginning a journalism unit.

Some former students undertake activities outside, where the environ-ment (soil, snow, river) becomes part of the learning experience. (See examples

below.) Others participate in activities that otherwise they could do inside a conventional classroom (e.g., play language games).

- Going outside to create art with what could be found in nature (Danya; Grade 6).
- Planting the *three sisters* (squash, corn, beans); comparing Indigenous agricultural systems with imported European ones.

> Outside, getting kids to work the soil, for some it's a first . . . some are totally disconnected from nature. . . . Seeing this ancient practice, better in terms of respecting the earth, is something that I find important; . . . kids need to practice what they're learning, it's the best way to learn, it makes teaching more interesting. (Meghan; History 11)

- Walking along the Seine River, observing flora and fauna, appreciating nature, studying ecology (Phil; Science).

For participants, the benefits of learning in and from the community and the environment are numerous. These include pupils being able to live and witness concepts in environments where they genuinely occur, which pupils find engaging. As one participant noted:

> Getting out of the classroom is more inspiring, it's better for creativity. Outings allow us to see unknown facets of some young people, sometimes who might be a little difficult in class, they give you a chance to create a bond that would be impossible to make in class. (Annick)

Their numerous examples, of which only a sample could be included here, show how these experiential, community-based strategies are transferable to teaching all sorts of things. Their words attest that community members are willing and even enthusiastic to participate in the learning process.

All participants invite community members to speak to their pupils. In their interviews, they explained how these guests allow for broader discussions to occur, exposing pupils to alternative perspectives. For example:

> Inviting people from the community . . . was always something special. Normally they arrived with tools of their trade . . . the paramedic arrived with his ambulance bag-of-things, the young people get on board very quickly. (Phil)

The role of the community is also evident when it comes to pupils being able to act upon their learning, an important part of ESE. Occasions for pupils to act upon their learning often, if not always, occur in human or natural environments; examples of these include: trying to influence their school community itself (e.g., awareness-raising campaigns around recycling or bullying) or trying to contribute with the more general public (e.g., community improvement initiatives, fundraising for disaster relief). One participant identified this step to act-on-learning as challenging.

The authenticity of learning in and from the community can be used to influence pupils' sense of identity and agency. Many participants noted that a fundamental part of learning in and from the community is relationships. Meghan, Natasha, Rachèle, and Stephany all talked about how living meaningful experiences in a French community helps pupils—both immersion and Francophone by birth—develop a Francophone cultural identity and a sense of belonging. These experiences include volunteering with recently-arrived Francophone refugees, participating in the Francophone improvisation league, participating in the Conseil Jeunesse Provincial, and writing letters in French to municipalities and organizations. This building of relationships, and how it contributes to the development of a francophone cultural identity and a sense of belonging, are key factors for ensuring the longer-term viability of our minority Manitoban Francophone community.

Facilitating experiential, inquiry-based learning. For teaching concepts at all levels, all participants from C&I Science courses use experiential and hands-on activities, such as experiments, dissections, and technological problem-solving (design process).[3] They notice that these pedagogical strategies help their pupils better understand concepts and enhance their scientific curiosity. They also observe how highly motivating these strategies are. One participant, who is now teaching middle years, talked about how she links brain development with adolescent well-being, a prevalent concern for her. Activities include doing a brain dissection with Biolab, building a model brain for their classroom, and doing workshops on anxiety (facilitated by the guidance counsellor). Other examples of applying experiential strategies to Science teaching include: hypothesizing and experimenting if air takes up space (Janelle; early years); exploring a unit on optics by using mirrors, light, colours, and by doing an eye dissection (Melissa; middle years); doing experiments on the five types of chemical reactions (Kelsey; senior years).

Relating science issues to society, many participants—particularly those teaching at middle and senior years—explicitly discuss ethical concerns pertaining to science with their pupils. For example, one participant does debates on biogenetics, organ transplants, and other ethical issues with her biology class. Miguel, a high school teacher, discusses questions about "designer babies" in genetics; when discussing ecosystems, he talks about ethical and human implications of climate change, exploring what we can and should do to help those affected.

In their Social Studies and Language classes, many participants use age-appropriate simulation games, role-playing and debates to explore multiple perspectives on, and impacts of, historical events, topics, and current issues. These activities are experiential and provide opportunities for pupils to explore topics about which they are interested. Examples participants gave included: engaging in role-plays where pupils choose a stakeholder or affected group, research that perspective, and argue and present it; doing activities such as Kairos' blanket exercise, which presents Canadian colonial history from Indigenous

perspectives; and debating controversial real-world issues chosen by the pupils. Participants do research projects for which their pupils choose topics, create guiding questions, research these questions, and share their findings.

Importance of relationships. A fundamental underlying aspect that emerged during initial interviews was the importance of establishing healthy relationships to integrate these ESE pedagogical strategies and topics in a meaningful way. As is true with university-level learning contexts, participants stated that good, respectful relationships between teachers and pupils, and among pupils, help create healthy, safe, positive learning environments. Within these environments, diverse perspectives are more likely to be shared, which in turn enriches discussions and deepens understanding about complex issues. Three participants explained how good relationships with pupils enable teachers to tailor learning to meet pupils' needs and interests. Natasha said: "Without a relationship of trust, learning won't go far. We need to know our young people's interests to be able to get them involved." These three participants were not alone in feeling that fostering good relationships helps to provide meaningful learning experiences for pupils. Positive relationships with people and places in community help facilitate collaborations and, as Rachèle and Meghan noted, are more likely to result in getting their pupils to care about issues: "how can you feel concerned about something if you've no connection with it?" (Rachèle)

Sharing the responsibility of learning with pupils. Participants often share the responsibility of learning with their pupils. This sharing of responsibility is manifest in many ways depending on grade level and subject area. For co-constructing curriculum, nine participants provided examples where pupils have voice as to the topics to be explored. As for evaluation, seven participants shared, through discussion with their pupils, how they determine evaluation criteria, course content, forms of representation, and assignment due dates. Five participants explained how they create class rules and decide on classroom-management strategies together with their pupils.

Overall, participants communicated that when they teach in this sharing-responsibility way, their pupils are more engaged and more motivated to learn, resulting in a positive learning environment with fewer classroom-management problems. They remarked that this sharing of decision-making often makes pupils feel more responsible for their learning.

Constraints or challenges to integrating ESE pedagogical strategies. Not surprisingly, participants identified challenges that inhibit teaching in the aforementioned ways. These include logistical constraints (e.g., lack of time, finances, transportation, supervision, cumbersome administrative process) and limited access to certain resources and opportunities (e.g., lab equipment, supplies; French-language programming at educational sites). Contextual challenges include physical proximity to sites, resources, and teaching in an unsupportive climate (e.g., resistance from parents and/or

administration; school having other priorities). Participants identified pupils' lack of readiness as a potential challenge for discussing certain topics. Four participants described how the breadth and diversity of pupils' abilities and maturity within a specific grade level sometimes make it challenging to create appropriate, engaging activities for all learners. Three participants commented that classroom management could be more challenging in less-structured environments, such as when teaching in community settings. Depending on grade level, a particular curriculum might lend itself more or less easily to teaching certain topics.

Discussion

Different scholars have identified certain ESE pedagogical strategies as particularly impactful in pre-service teacher education in terms of their influence on students' future teaching practice: experiential, community-based, and inquiry-based strategies (e.g., Evans et al., 2017; Inwood & Jagger, 2014; Karrow et al., 2016). These strategies are intentionally used in the C&I courses taught by Sims and Asselin, and the research study presented here suggests that, at least in the perception of the study participants, the way these strategies were used when the participants were enrolled in these courses had an overall positive impact on the participants' actual teaching practice. In this section, we discuss what the study findings contribute to the effectiveness question posed by Evans et al. (2017). We then discuss the research findings in light of existing scholarship to address Evans et al.'s (2017) critical reflection question.

The Effectiveness Question

In this section, we discuss the effectiveness of the use of the described ESE pedagogical strategies in the C&I courses in terms of influence on participants' understanding of teaching and learning of Social Studies and Science and on their use of these pedagogical strategies in their own school teaching.

Overall, results suggest that modelling, providing opportunities to practice the strategies through planning, experimenting, and facilitating community-based activities helped participants gain knowledge, skills, and confidence in their application of these strategies and in exploring how to innovate with these strategies in different contexts. These findings parallel the benefits suggested by Inwood and Jagger (2014) and Evans et al. (2017) for these ESE pedagogical strategies.

All seventeen participants remarked that community-based strategies, in particular, were memorable and impactful. These research findings support Kozak and Elliot's (2011) and Inwood and Jagger's (2014) assertion that experiencing community-based strategies and going *outside* the conventional classroom open up possibilities previously unimagined by participants. For six participants, doing so opened up their concept of what "teaching" means. Far

from simply delivering curriculum, they learned that they could be positive influences on pupils' lives, on the viability of their community, and on their environment. Inwood and Jagger (2014) write that "including experiential forms of learning in initial teacher education . . . takes a more holistic approach that involves 'the heart, the hands, the head and the spirit' in learning" (p. 33). Community-based strategies engender hope (Block et al., 2016) and, as our own findings suggest, are enjoyable and interesting to live.

Regarding the efficacy of ESE pedagogical strategies used to teach inquiry-based learning, results show that they did facilitate student learning. Particularly effective in the C&I Science courses were experiential learning activities, including modelling scientific experimentation.

Learning to use the local community and its environment as sources and contexts for learning resonated with participants. The numerous examples they provided speak to how they are using these community-based strategies in their teaching to: reinforce/present concepts with experiential learning; explore complex, real-world issues leading to learning about how our communities and society work (Kozak & Elliot, 2011).

For developing the specific skills (e.g., critical thinking, research) necessary to support inquiry-based learning (Chiarotto, 2011), greater attention could be placed on teaching students how to generate and refine critical questions. Findings from this study clearly show that experiential activities are effective in facilitating longer-term learning. Consequently, specifically in the C&I Social Studies course, more experiential activities could be incorporated into teaching inquiry-based processes, for example practicing observational skills outdoors.

Reflecting on the importance of providing opportunities for students to apply and act on learning, perhaps an aspect that makes these community-based and inquiry-based strategies impactful is that they lead to a sense of agency, providing opportunities for students to act on issues they care about through their professional practice. Influencing their pupils' sense of identity and belonging by enabling meaningful experiences in Manitoba's Francophone community is evidence of such action. As two participants (Rachèle and Meghan) observed, if you have connection with something, you will care and do something about it.

Relationships emerged as an important theme in terms of the efficacy of these strategies. Jickling, Blenkinsop, Timmerman, and De Danann Sitka-Sage (2018) call for teacher education that involves learning that is loving, caring, and compassionate so that humans may develop rich relationships with each other and with members of the more-than-human world. They argue that these relationships of reciprocal care would be part of overcoming the alienation that exists between many humans and the natural world. Participants such as Annick, Janelle, Phil, and Rachèle, amongst others, shared that using these ESE pedagogical strategies can contribute to the building of these healthy relationships. As testified by participants, in using experiential, community-based, inquiry-based strategies, teachers and learners can discover

different facets of one another; learning can be tailored according to learners' interests creating positive, respectful learning environments that contribute to the sharing of diverse perspectives. As a result, learners are more engaged in the learning process. For some participants, such as Natasha and Meghan, witnessing the communities' openness to collaborating with pupils has been profoundly inspiring and meaningful for them as educators as it has been for their pupils. Responding to Jickling et al.'s (2018) call, examples such as meeting veterans, Indigenous Elders, and scientists can lead to building understanding and empathy.

UNECE (2012) provides certain recommended competencies for educators in ESE. Learning the aforementioned ESE pedagogical strategies helped with the development of these competencies. For instance, participants' used the ESE strategies to: create opportunities for sharing diverse perspectives and experiences; connect learners to their local, global spheres of influence; and use their natural, social, and built environments as contexts for and sources of learning. Participants' words and actions show that they learned how to be facilitators and participants in learning processes. The breadth of how they have applied their learning in their teaching contexts shows creativity, innovation, and a commitment to engaging in ESE.

The Critical Reflection Question

First, the study itself raises the methodological question of the limitations of the findings. While a range of former students were invited to participate in the study, participants self-selected themselves into the study. Former students who did not work as teachers did not qualify for the study, and some potential participants might have decided not to participate because they did not find the employed ESE pedagogical strategies particularly effective for them. Furthermore, the study was designed to exclusively explore former students' *perceptions* of the strategies and their impact on their learning and own teaching practice.

Second, the findings on the first research question provide for some critical reflections on the use of the ESE pedagogical strategies used in the C&I courses that this research studied. Participants recommended a more extensive exploration on how to frame curriculum that uses an environment and sustainability lens during the C&I courses. Indeed, this would be beneficial as it could help clarify broader purpose within their professional practice, exploring how students could meaningfully contextualize specific (often locally-relevant) subjects within larger, pressing real-world issues (e.g., climate change, biodiversity loss, mass migration). For the C&I Science courses, this could mean deeper engagement with how to contextualize scientific learning with science-technology-society-environment issues. For the Social Studies course, this could involve a greater focus on the environmental and social impact of human behaviour. As one participant's challenge suggests with regards to the step to

act-on-learning, providing concrete examples of what the implementation of particular strategies looks like, and how they translated to opportunities for pupil action, could help students better imagine possibilities. The responses by participants to the first research question demonstrate that it is not possible to talk about the effectiveness of a particular ESE pedagogical strategy, but that one always has to consider how a specific strategy was implemented, which is in itself situational and always idiosyncratic.

Third, the claim of the relative effectiveness of the ESE pedagogical strategies needs to be seen in light of the challenges that participants face in their teaching context. Almost a third of them expressed a need for encouragement or permission to use ESE pedagogical strategies, particularly community-based ones, in their teaching. This finding is not surprising considering the current educational climate, which includes an emphasis on test scores, a reluctance to teaching controversial issues, and a long history of teachers shaping classroom practices based on perceptions of community values (e.g., Chikoko, Gilmore, Harber, & Serf, 2011; Evans et al., 2017). Consequently, it is important for pre-service teacher education courses concerned with ESE pedagogical strategies to inform students of supportive existing policy (e.g., Manitoba Education, 2016), provide theoretical foundations for integrating ESE pedagogical strategies, and explore how to negotiate the potentially delicate space of integrating ESE topics and pedagogies so that they can respond if and when faced with resistance.

As participants' responses demonstrate, one of the biggest challenges in implementing certain ESE pedagogical strategies, particularly community-based ones, is teachers' ability to adequately accommodate the diverse needs of learners and manage pupils' behaviour in less-structured environments, both of which are integral to the proposed ESE pedagogical strategies. ESE-focused pre-service teacher education courses cannot be ignorant about this challenge; they need to address these concerns about physical and pedagogical challenges head-on. For our C&I courses, that could mean, for instance, teaching students how to plan integrating concepts from the Universal Design for Learning, described as a proactive method for designing and delivering flexible approaches to teaching that address student diversity (Meyer, Rose, & Gordon, 2014).

Conclusion

It has been affirming to us as teacher educators to see that what we considered and observed anecdotally to be effective strategies are indeed effective in the sense that our students (at least those that participated in the study) are applying similar strategies in their teaching. In times where global news is so bleak (e.g., Worldwatch.org), this is wonderfully inspiring and hopeful. It inspires us to be more creative and critical in our thinking, and to go deeper with ESE

concepts in our practice. In particular, it inspires us to make community-based learning as inclusive as possible and to further develop opportunities to act on learning through environmental stewardship and activism (Anderson et al., 2018; Block et al., 2016; Inwood & Jagger, 2014). These pedagogical strategies facilitate relationship building with communities and places; they help develop love and empathy so that we all contribute to the well-being of all, forever; they provide opportunities to hear a variety of perspectives on multiple issues; they promote curiosity and develop skills necessary to pose critical questions and to do research that can lead to informed action. All of these are essential in learning to deal with the complexities of the environmental and sustainability issues we face.

This case study contributes to Evans et al.'s (2017) call for empirical research into the efficacy of certain ESE pedagogical strategies used in pre-service teacher education by examining the longer-term impacts of the use of these strategies in Social Studies and Science C&I courses.

Notes

[1] Herein, the term "student" refers to university-level learners and the term "pupil" refers to K–12-level learners.
[2] Wiggins and McTighe (2005) propose using "essential questions"—ones aimed at stimulating thought. These provoke inquiry and become a means of addressing questions central to understanding key issues.
[3] Technological problem solving seeks solutions to practical problems. It requires the application of scientific knowledge in various ways (Manitoba Education, Citizenship and Youth, 2006).

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