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Developing a Global Perspective in / FOR Science Teacher Education: The Case of Pollination

Développer une perspective globale en / pour la formation desenseignants en sciences : le cas de la pollinisation

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Résumé de l'article

Quel que soit le niveau auquel ils enseignent, les enseignants en sciences peinent à soutenir le rythme. Ils naviguent entre le développement rapide de connaissances liées aux causes et solutions potentielles des problématiques environnementales actuelles, tout en essayant d'inspirer l'enthousiasme auprès d'une nouvelle génération de scientifiques passionnés et informés. Or, comment les futurs enseignants en sciences peuvent-ils rendre la formation en sciences plus intéressante et pertinente pour leurs élèves? Dans un style narratif, cet article décrit les pratiques éducationnelles utilisées au sein d'un cours de méthodologie d'enseignement des sciences au secondaire, dans le cadre d'un programme de formation initiale en enseignement au Canada. De manière plus spécifique, celui-ci s'inspire des idées présentées dans le cadre d'Agenda 21 (ou Action 21) et des Objectifs du Millénaire pour le développement de l'Organisation des Nations Unies pour examiner les dimensions socio environnementales (un aspect souvent négligé) de la pollinisation. En fait, l'activité proposée vise à développer chez les enseignants en biologie au secondaire l'adoption d'une perspective éducationnelle et globale du programme en (a) leur faisant prendre conscience des conséquences environnementales négatives de la quête des humains en termes de développement durable et de protection de l'environnement et en (b) questionnant les conceptions traditionnelles à la base de l'éducation scientifique et environnementale.

NOTES FROM THE FIELD / NOTES DU TERRAIN

DEVELOPING A GLOBAL PERSPECTIVE IN / FOR SCIENCE TEACHER EDUCATION: THE CASE OF POLLINATION

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ABSTRACT. Science educators at all levels continuously struggle to keep pace with the rapidly developing understanding of the causes and potential solutions to current environmental issues while also trying to enthuse a new generation of passionate and knowledgeable scientists. However, how can future science teachers make science education more attractive ad meaningful to their students? The present paper describes (in a narrative style) an instructional practice that has been performed within a secondary science methods course in a teacher preparation program in Canada. More specifically, it draws on ideas presented in Agenda 21 and the United Nation's Millennium Development Goals to study the (often neglected) socio-environmental aspects of pollination. Ultimately, the proposed activity aims at promoting the ability of pre-service high school biology teachers to adopt a global education perspective on the science curriculum by (a) recognizing the unintended negative ecological impact caused by humanity's pursuit of sustainable development and sustainability and (b) reexamining traditional conceptions of scientific and ecological literacies.

DÉVELOPPER UNE PERSPECTIVE GLOBALE EN / POUR LA FORMATION DES ENSEIGNANTS EN SCIENCES : LE CAS DE LA POLLINISATION

RÉSUMÉ. Quel que soit le niveau auquel ils enseignent, les enseignants en sciences peinent à soutenir le rythme. Ils naviguent entre le développement rapide de connaissances liées aux causes et solutions potentielles des problématiques environnementales actuelles, tout en essayant d'inspirer l'enthousiasme auprès d'une nouvelle génération de scientifiques passionnés et informés. Or, comment les futurs enseignants en sciences peuvent-ils rendre la formation en sciences plus intéressante et pertinente pour leurs élèves? Dans un style narratif, cet article décrit les pratiques éducationnelles utilisées au sein d'un cours de méthodologie d'enseignement des sciences au secondaire, dans le cadre d'un programme de formation initiale en enseignement au Canada. De manière plus spécifique, celui-ci s'inspire des idées présentées dans le cadre d'Agenda 21 (ou Action 21) et des Objectifs du Millénaire pour le développement de l'Organisation des Nations Unies pour examiner les dimensions socio environnementales (un aspect souvent négligé) de la pollinisation. En fait, l'activité proposée vise à développer chez les enseignants en biologie au secondaire l'adoption d'une perspective éducationnelle et globale du programme en (a) leur faisant prendre conscience

des conséquences environnementales négatives de la quête des humains en termes de développement durable et de protection de l'environnement et en (b) questionnant les conceptions traditionnelles à la base de l'éducation scientifique et environnementale.

> Hey farmer, farmer
> Put away that D.D.T. now
> Give me spots on my apples
> But leave me the birds and the bees, please
> ("Big Yellow Taxi," Joni Mitchell, 1970)

What types of literacy need to be embraced by pre-service science teachers throughout their careers to bring about a world of sustainability, greater socio-environmental justice, equity, peace, and Human Rights for all? More importantly: how can science teacher education contribute to the process? Science is a well-known and significant aspect of the existing movement for the inclusion of environmental education (EE) into teacher education programs worldwide (e.g. Bodzin, Shiner-Klein & Weaver, 2010; McKeown & Hopkins, 2005; Weiland & Morison, 2013). Indeed, science educators at all levels continuously struggle to keep pace with the rapidly developing understanding of the causes and potential solutions to current environmental issues while attempting to attract and educate a new generation of passionate and knowledgeable young scientists (Lewis, 2006). In general, this EE-oriented approach to science education is a strategy to prompt individuals to reflect on their own behaviours as means to change those personal attitudes and values that are detrimental to "our" — i.e. commonly shared — environments. In the case of (science) pre-service teachers, the fact that their life narratives are strongly woven to their working identities (Connelly & Clandinin, 1999; Kosnick & Beck, 2009) also creates the possibility for any transformation to be assimilated and multiplied by as many students as there are in their future classrooms (McDonald & Dominguez, 2010).

Regardless of the potential criticisms and obstacles to doing an education in / for / about the environment (e.g. Jickling, 1992; Russell, Bell & Fawcett, 2000; Reis, 2009; Reis & Guimaraes-Iosif, 2012; Reis, Guimaraes-Iosif & Reis, 2009), the combination of science and environmental education undoubtedly offers an opportunity for science educators (and their students for extension) to bridge prior experiences with new ones that are lived (acquired) through school towards the development of their scientific and ecological literacies (e.g. Reis, in press; Reis, Ng-A-Fook & Glithero, in press). In this context, the concepts of "sustainability" and "sustainable development" emerge as key elements (Inwood & Jagger, 2014; Mintz & Tal, 2013; Nolet, 2013). Actually, Agenda 21 (United Nations' Sustainable Development, 1992) made

"sustainability" a central component in many of its chapters, which helped the notion of 'education for sustainable development' to be taken up as an overall valuable approach to science and environmental education in schools (Sandell, Öhman & Östman, 2008; Walshe, 2008). Furthermore, these ideas are well situated within the field of "global education" (Mannion, Biesta, Priestley & Ross, 2011), which is an educational domain characterized by the generation of pedagogical actions oriented towards giving people a wider appreciation of the diversity around them as well as the urge to overcome worldwide social injustice (Asbrand & Scheunpflug, 2006). However, the possibility of exploring the intimate relationship between these topics in attractive and meaningful ways to students can be easily overlooked by future (science) teachers (Patrick, Macqueen & Reynolds, 2014).

It is therefore from the perspective that the adoption of a global perspective is much desirable for the improvement of the existing teaching and learning processes in science teacher education programs that the present paper introduces an instructional practice that has been performed within a science (biology) teacher preparation course in Canada. Specifically, it uses the phenomenon of "pollination" as grounds to improve pre-service science teachers' understanding and appreciation for the incorporation of a global education perspective into their teaching repertoire for the expansion of their scientific and ecological literacies.

PEDAGOGICAL CONTEXT

As part of the teacher education program where I am a faculty member, I teach a course on high school senior biology each winter semester. It includes the analysis and application — or rather the attempt — of specific teaching strategies unique to this scientific discipline. Usually on the first day of class, I go over Edward O. Wilson's (2006) five principles on how to learn and teach science (biology): (i) teach each subject from the general to the specific in order to facilitate learning; (ii) reach outside the field to keep up with the current convergence of disciplines in the generation of new knowledge; (iii) focus on problem solving to reflect real life; (iv) drive deep into a specialty while acquiring a breath of experience in other areas; and (v) commit oneself with passion and dedication. In line with these recommendations, I challenge my students to consider a somewhat unconventional approach to the mandated provincial science curriculum. It is "unconventional" in the sense that it goes against their initial expectation — revealed in the course evaluations — to learn how to "deliver" the official program (i.e., implement, apply or execute it). (Personally, this perspective has always given me the impression that some of my students understand these documents to be like checklists that they are required to complete once they start teaching). As part of the challenge, I insist that my students consider choosing themes for their mock teaching presentations and practicum placements that satisfy not only Wilson's principles, but also those

that they "gut feel" are important for both themselves and their high school audience. I ask them to select themes that they believe represent "windows of opportunity" to promote student engagement and critical thinking in science — and environmentally oriented topics are always on their list.

One of the underlying reasons for adopting this teaching approach is to demonstrate that science teachers have hunches that can be trusted even though they might not be directly contemplated in any curriculum documents. This, in turn, defies more traditional conceptions of scientific literacy, which are frequently associated with the "ability" to memorize and repeat back factual information. Instead, I aspire them to adopt a more comprehensive (i.e., ecological) literacy model that includes a view of science education that promotes their capacity to recognize and effectively deal with the inherent complexity and controversy of humanity's pursuit of sustainable development and sustainability (Colucci-Gray, Camino, Barbiero & Gray, 2006). After all, teachers' conceptions of scientific and ecological literacies often presuppose particular views of knowledge acquisition (Roth & Lee, 2002) that mediate their decision to adopt — or reject — specific teaching pedagogies (Corrigan, Cooper, Keast, & King, 2010; Good & Govender, 2010), including those that are globally focused. Ultimately, a global perspective has the potential to making learning relevant by extending one's views of the world and connecting school (science) topics with daily life (Çimer, 2012).

In my efforts to provoke students in my class to adopt a global perspective in science education, my preference for human-inclusive themes has proven to be rewarding — for instance, food (in)security, teenager obesity, hunger, poverty, consumerism, social justice, bullying, and prejudice (e.g. Andrzejewski, Baltodano & Symcox, 2009; Floud, Fogel, Harris & Hong, 2011; Martusewicz, Edmundson & Lupinacci, 2011; People of Colour Environmental Leadership Summit, 1991; Unterhalter, 2012). This is mostly because our species occupies an interesting niche in our collective imaginary of the natural history of the planet: although we are a very recent and fragile species, we have managed to misled ourselves into believing that we have full control over the duration of our continuing existence. Thus, the existing belief that science and technology advancements can fix the current environmental problems (e.g. Scott, 2011) or the eternal quest for the "elixir of eternal youth" (e.g. Villeda et al., 2014). Likewise, it goes against the typical anthropocentric tendency of my students to disregard humans as an intrinsic part of their ideals of nature (Reis, Dionne, Valeri & Freiman, 2013). This, in turn, confirms a common tendency that humans have to see themselves as separate from the surrounding environment, and which has important ethical implications (e.g. Kortenkamp & Moore, 2001; Schultz, 2002). The next section outlines in more detail the different elements of a particular instructional practice designed to assist future science teachers in adopting a global perspective in their classrooms.

POLLINATION: AN INSTRUCTIONAL PRACTICE

The class starts with two questions: What it means to be scientifically literate? Why is this concept any important for the teaching of the science curriculum? Then, I play a clip with a series of short interviews with seemingly scientifically ignorant Harvard graduates — only to the amazement and amusement of my students. In the video, the interviewees incorrectly elaborate on the concept of photosynthesis in much the same way that junior elementary students do (Harvard-Smithsonian Center for Astrophysics, 1997). Next, students are paired up and given about 20 minutes to complete a forty-odd multiple-choice test on various science topics (there are many versions available online), which makes the answering rate approximately to be about 30 seconds per question. I make it a small group activity so that students avoid feeling bad for not getting all the answers right — that is, there is always someone else to "share" the blame with. Similarly, the short timeframe is meant to prevent students from looking up the answers on their phones and laptops. Once the time is over, each group immediately marks their own tests as I call out the answers. At this point, students get loud in the classroom talking to their partners about their performance on the activity. Contrary to the initial expectations that my students might have had of performing better than the Harvard graduates, their disappointing results on the "pop quiz" serves as a nice segue into a discussion about what it means to adopt a "deficit approach" to scientific literacy (Laugksch, 2000). Indeed, the possibility of being considered scientifically illiterate troubles them — especially since they all have a science background of a sort. At this very point of class, our conversation highlights the inadequacy of a definition of scientific literacy that is strictly based on the cumulative retention and regurgitation of factual information.

We move on to jointly creating a list of global issues, partly assisted by the United Nation's Millennium Development Goals[1], which range from eradicating extreme hunger to providing universal primary education. Here, the objective is to identify suitable references for the possible re-signification of scientific literacy, one that is geared towards a more global perspective on the science curriculum. For example: poverty, green house gases, women's rights, malaria, etc. (Figure 1). The conversation is followed by a 2-minute long snippet of Louie Schwartzberg's talk on "the hidden beauty of pollination,"[2] which includes stunning images that he captured on the migration of butterflies. The renowned filmmaker also asserts that although pollination is vital to life on the planet it is largely unnoticed by the human eye. That gives me a chance to deliberately add pollination to the list of global issues and also to ask students about the possible reasons for doing so. It is an exercise that forces them to expand their thinking and create connections between science (biology) and various aspects of their lives, from food consumption to water distribution. I bring into the debate the "honey bee colony collapse disorder," the huge losses of hives it caused in some parts of the U.S. (United States Department of Agriculture,

2010) and the fact that our species has likely contributed to it through the use of pesticides and the contamination of water (Girling, Lusebrink, Farthing, Newman, & Poppy, 2013; Suryanarayanan, 2013; Suryanarayanan & Kleinman, 2013). Similarly, I allude to the effect of the killing — not to say "iatrogenic"[3] (a new word to many) — effect of barotrauma, or the dramatic drop in pressure that leads to severe hemorrhaging of lungs, that is inflicted by wind turbines to thousands of bats every year (Baerwald, D'Amours, Klug & Barclay, 2008). These fatalities come with a "price tag" as there is an astronomical economic value attached to the ecosystem services that we benefit from, like pollination (Constanza et al., 1997). I ask students to sum up all the lessons learned and stress the relevance of adopting a more globally and ecologically oriented perspective in their teaching careers. I also ask them once more to consider the importance of achieving scientific literacy. Finally, I conclude the class by talking about different ways the same ideas could be reproduced in different classroom environments — like the production of public announcement radio podcasts, development of fundraising activities, fieldtrips to the outdoors, and the creation of environmental ad campaigns.

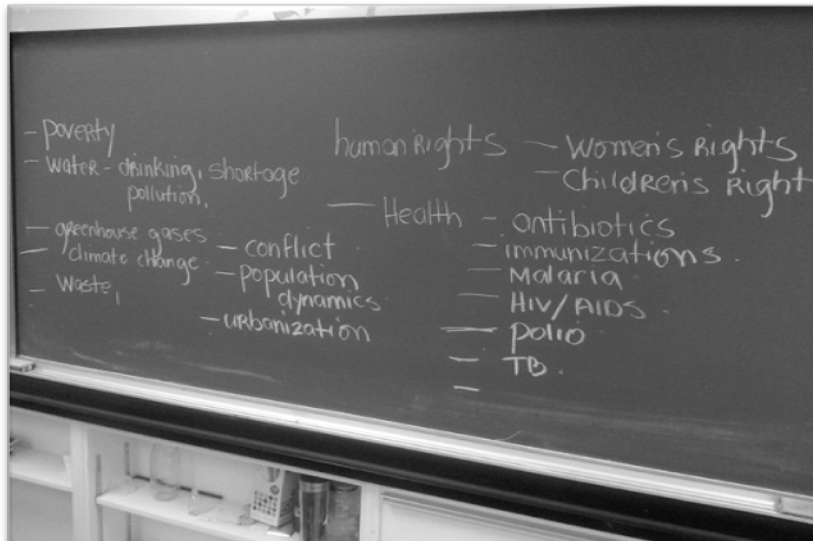

FIGURE 1: *"Anchor chart" based on the UN's Millennium Development Goals. Notably, pollination is not initially listed*

CONCLUSION

In part due to our "plant blindness" (Manetas, 2012; Wandersee & Schussler, 1999), pollination goes unnoticed even though it is complexly beautiful (Pollan, 2001; Stewman et al., 2010). Consequently, the "regulating services" provided

by pollinators (i.e., pest and disease control) and the "supporting services" delivered through the occurrence of pollination itself (i.e., crop pollination) (Millennium Ecosystem Assessment, 2005) can be simply too easily neglected in science (teacher) education. Not only that, but the consequences of any pollination "malfunctioning" — whether natural or anthropogenic — become invisible to our senses and therefore unlikely to be contemplated as a global issue by teachers and students. Ultimately, this "imperceptibility" can also prove to be an obstacle for those attempting to advance a global perspective — and sustainable education for extension — agenda in teacher training programs.

Many other topics (much like the ones listed in this article) can be used to support science teachers in their efforts to adopt a non-prescriptive approach to mandated science curricula and re-define scientific and ecological literacies — as opposed to teach their students for "science competency" (Mueller, Tippins & Bryan, 2012). Even other practitioners can adapt these pedagogical activities for use in their courses on similar issues if they are encouraged to consider the potential that their disciplines have to improve students' capacity to negotiate multiple forms of evidence and reasoning to make informed decisions. In any way, new teachers have the potential to become gateways to developing critical thinking, problem solving skills and active enquiry in everyday life (e.g., van Eijck & Roth, 2010). Only then, the meanings constructed from "texts" (nature and environment included, Stables, 1996) will likely serve to keep people healthy, safe, peaceful and civically active beyond their abilities to read and write science.

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NOTES

1. http://www.un.org/millenniumgoals
2. http://www.ted.com/talks/louie_schwartzberg_the_hidden_beauty_of_pollination.html
3. Although the word "iatrogenic" is usually taken to refer to an undesired consequence on a person of a medical treatment given by a medical professional — e.g., an illness caused by the action or treatment of a doctor — here it is intentionally used as a metaphor to the fact that the use of windmills as a solution (i.e. "treatment") to the energy problem (i.e. "illness") has undesired effects. Thus, the negative ecological impact of our pursuit of sustainable development mentioned earlier.

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