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Monica Gutierrez
Ontario Institute for Studies in Education, University of Toronto

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Digging deep for mining education ethics: Canadian higher education in the global arena of resource extraction

Monica Gutierrez
Ontario Institute for Studies in Education, University of Toronto

Abstract: The purpose of this paper is to assess the state of ethics training in mining engineering education in Canada. The paper takes into account the context in which mining engineers operate, especially international projects located in the Global South and Latin America. Increased training could prepare mining engineers with a better grasp and response to the ethical debates that plague mining operations in Canada and abroad. Since 65% of mining companies in the world are based in Canada, changes in the way Canadian universities train future mining high-level employees could have a worldwide impact. As this system is neither neutral nor ahistorical, links are made between Canada’s current mining educational practices and issues of colonial education using a critical lens. Mining engineering education is thus contextualized through the lens of colonialism. The paper looks at present-day engineering education in Canada and the state of ethics training within this curriculum, with a short analysis of two universities’ mining engineering programs. It will conclude with a set of recommendations that could provide Canadian-trained engineers more tools to navigate ethical issues in mining operations. The paper will have an International Education outlook, where the education of one’s nation affects living conditions in another nation. The case for stronger ethics training in mining engineering education has strong potential value for the Comparative Educational field. Currently there appears to be a lack of information about this topic and potentially this paper will fill this gap.

The purpose of this paper is to take a critical look at the role of ethics training in mining engineering education in Canada. Although ethics training already exists in engineering education, the different contexts in which mining engineers are trained and operate, especially when it involves international projects located in the Global South, call for more detailed, critical training. Ethical education for mining engineers could involve increased understanding and critical thinking to assess the impacts of mining
projects on stakeholders and mitigate or avoid negative impacts. In order to increase ethical training in the field, educators must consider who benefits and suffers from this type of education. Mining education has neglected to include these critical ethical considerations. This paper will detail how the knowledge produced in mining engineering programs is in conflict with and affects the little ethics training that might be in place currently. By analyzing some specific examples of what mining engineering education looks like in Canada the paper will develop a case for amplifying ethics training and offer suggestions of what this training would entail. The paper will also have an International Education outlook, considering where the education of one’s nation affects the living conditions in other nations. The changes needed go beyond education and are part of structural issues much larger than university programs. This type of change can have repercussions throughout the industry, and that even though one change will not make a large-scale difference, it is still an important step.

First, a brief definition of ethical education in mining engineering will be outlined, and the potential of education for social change will be assessed. The theoretical bases on how to fit the pieces of mining education, mining conflicts, local and global societies will be explored. Theories informing this paper are structural functionalism, where society’s “structures must function effectively and in cooperation with others in order for societal health to be maintained” (DeMarrais, 1999, p. 5) and a world systems approach where the globe is seen as “integrated but with two major unequal zones” (Spring, 2008, p.334). This paper will highlight the current problematics of mining in the Global South, considered one of these unequal zones. The Global South can be understood as a selection of countries previously called the Third World, that have historically received aid that is tied to the acquisition of raw materials and growth of new markets for industrialized nations (Hanlon, 2010, p.19). A specific focus on gold mining in the region of Latin America will allow for tangible examples to work from, and to narrow the socio-economic context in which Canadian mining takes place abroad. Mining engineering education will then be contextualized through the lens of colonialism, as Canada is a colony to a larger empire, and as Canada continuously expands its resource extraction agenda into other nations. The paper will then look at present-day engineering education in Canada, and the state of ethics training within this curriculum. A short analysis of two universities’ mining engineering curriculums related to ethics will be fleshed out. Finally the paper will conclude with a set of
recommendations that, considering the previous discussion, could improve the state of responsible and ethical mining operations when they involve Canadian-trained engineers. The paper will move from looking at the macro level, to the micro level of training within mining engineering education in specific university programs.

Ethics, Education and Social Change

The most important question before engaging in analysis of the ethics training of mining engineers is whether a change in the ethics curriculum of these programs can in turn create social change. In order to do this, ethics training as a concept must be defined in the context of mining engineering. Ethical training in the engineering professions is currently very narrow in scope. As required by the Canadian Engineering Accreditation Board, basic ethical training requires an ability to analyse “the impact of engineering on society and the environment” (Engineers Canada, 2013, p.13). The definition does not imply that engineers will act on their analysis. Germany drafted an Engineer’s Confession which placed “professional work at the service of humanity...[respecting] the dignity of human life...without regard for distinctions of origin, social rank, and worldview” (Downey, 2007, p. 471). These two examples point to what ethical training might look like for the broader engineering field. The primary efforts in the mining engineering field regarding ethics are “structured around two principal concepts: transparency and corporate social responsibility [CSR]” (Siegel, 2013, p.10). Transparency deals with exposing economic transactions between sectors, not with environmental or stakeholder impacts and CSR has been widely criticized as insufficient due to its voluntary nature (Hart, 2012).

Drawing from Cragg’s ethical model, ethical education for mining engineers could involve the understanding and ability to apply knowledge about the impacts of mining projects on stakeholders, and considering aspects such as flora, fauna, water, indigenous culture and knowledge, and human rights as stakeholders in the process. This includes consciously identifying all (including involuntary) stakeholders, mitigating risks for voluntary and involuntary stakeholders, and avoiding “harmful impacts...from which recovery is difficult...or perhaps impossible” (Cragg, 1995, p. 231). Training that allows mining engineering students to evaluate “projects from the perspective of all stakeholders” (Cragg, 1995, p. 232) would ensure students are more sensitive to the impacts of their work on others. Ethical training in mining engineering
needs to include increased critical thinking about the “reconciliation of extraction with ecological limits” (Siegel, 2013, p. 11) and the economic realities of extraction in a world of integrated but unequal zones. Programs of study that teach methods of industrial mining must integrate concepts of resource scarcity and examine the ways that stakeholders are impacted by a multinational extraction model.

In order to evaluate if developing this ethical training would be beneficial, a larger issue needs to be considered, as Farrell has, on whether education can “build a new social order” (2003, p. 150). In the 1960s assumptions about education optimistically stated that increasing “the availability of education...would produce net social benefits, increasing the total amount of wealth in a society and improving its distribution” (Farrell, 2003, p. 147). As the reforms were implemented, structural inequalities remained (Farrell, 2003). Potential reasons for the reforms not working as expected included partially implemented plans, policies informed by incomplete knowledge, and lack of coinciding factors to support the reforms. Essential factors that need to be in place as educational reforms are implemented are prime and specific political, economic and social conditions. When these conditions align, wealth creation and social benefits can occur in nations.

Looking back at the need for ethics analysis in mining education, an assumption can be drawn that if a specific set of conditions are met, ethics reform could have great positive benefits. By looking at the scope of impact mining education in Canada has on the country and the rest of the world, this reform seems quite necessary. Industry statistics illustrate this necessity. An extrapolation from Canada’s Mining Industry Human Resources Council’s recent report illustrates that 27% of the total workforce required to operate a typical large, modern mine are engineers (Heirdrich, 2013, p.2). By rough estimates, around 75% of mining companies in the world are based in Canada, so any changes in the way that Canadian mining employees approach their work will have a world-wide impact. In addition, changes of this sort are important because of the “unbalanced bargaining power, research capability and privilege access to information that mining companies usually have” (Cragg, 1995, 230).

Applying Farrell’s analysis to mining education, it can be argued that any ethical reform within the mining engineering curriculum would need to be accompanied with political will to improve ethics around Canadian mining operations at home and abroad, economic will to prioritize responsible mining above profits, and social
pressure for the importance of upholding human rights and environmental protections in resource extraction operations. These are factors that would need to occur inside and outside the boundaries of higher education, to maximize the benefits of increasing ethics training in mining engineering programs. Given the size of Canadian mining operations, any change in the way employees of this sector are trained will have a wide-spread impact at their workplaces. As the layers of these interconnected issues unravel themselves, it becomes clear that mining engineering education does not function outside the context of the larger society at local and global levels. Therefore it is critical to conceptualize the relationship between mining engineering programs in Canada and the broader society they operate in.

Society and Mining Education

Within the confines of this paper, the problematics of the mining apparatus are seen from a structural functionalist perspective where society’s “structures must function effectively and in cooperation with others in order for societal health to be maintained” (DeMarrais, 1999, p. 5). Through this lens, mining – and mining education – are part of the larger system as components necessary for its functioning, and must function in cooperation with other parts of society in order to maintain order and health. Order and health can look like: the upholding of human rights, the protection of culturally important environmental resources, protection of ecosystems, and working in cooperation with affected or local community and Indigenous groups.

Following this theory, workers of all professions need to function harmoniously with the whole of society and the resource extraction apparatus. For example, if mining engineers are not educated in a way that allows them to be critical and responsible of their projects, then society is unhealthy, both locally and globally. However, local and global effects are not equal, and different regions are affected in different ways. The world systems approach sees the globe as integrated but with two major unequal zones (Spring, 2008, p.334). Nations from the core zone, which includes Canada, have an interest in maintaining their economic position through political and education policy. This directly affects the way Canadian mining companies and Canadian universities offering mining engineering programs perceive the periphery zone, which includes Latin America.

In the larger macro level of mining engineering education, the function of the
career within a global system of resource extraction is both essential and ethically incomplete. The lack of critical, engaged and contextual ethics benefits the core nations/communities, of which Canada can be counted as a member, and creates disadvantages for periphery nations/communities. As governments might have different interests and alignments than their citizens, in this paper I will apply structural functionalism and world systems theory at the community levels. In this distinction, it is important to acknowledge that specific communities are affected by these dynamics, as even within Canada, First Nations struggle with mining and resource extraction conflicts. New possibilities of analysis arise looking at societies instead of nation-states, for example, focusing on Indigenous worldviews vs. colonial worldviews (Spring, 2008).

Mining Conflicts: Gold Extraction in Latin America

The mining education and mining extractive systems are clearly unhealthy. Mining conflicts are reported with Canadian mining companies in Mexico, Guatemala, Honduras, Nicaragua, Colombia, Guyana, Suriname, Cuba, Puerto Rico, Ecuador, Peru, Bolivia, Brazil, Paraguay, Chile and Argentina (MICLA). Accusations against Canadian mining companies range from rape, kidnappings, and murder, to violations of human rights, of the right to organize, of free speech, illegal displacement, intimidation, and threats. Some of these accusations are currently being tried in Canadian courts (e.g., Choc vs Hudbay, 2014). There are many reasons for these conflicts, and each scenario is unique in its mix of factors.

As this paper progresses, it is unreasonable to speak of mining as if it were singular or coherent. There are a multitude of mining companies, with bases in Canada, that mine for various different resources in various parts of the world. The issues that arise from such large scale operations are varied. Siegel mentions that “there are many mining industries, and each has its own culture, directives, structure, purpose and pathologies” (Siegel, 2013, p. 8). For this reason, and in order to focus the paper within a set of boundaries, gold mining will be used as an example of the different kinds of issues arising from resource extraction projects. Gold is mined in various parts of Latin America, with varying levels of negative repercussions for local environments and communities. It has been argued that gold mining is one of the least necessary industry activities through campaigns such as “No Dirty Gold” ran by Earthworks (No Dirty
Gold, 2014).

In general, Canadian mining investment in Latin America is massive and “increasing, as part of a larger Canadian corporate drive for new spaces of capital accumulation” (Gordon, 2008, p.83). The process of metal mining, in particular gold, has a high environmental impact. This impact has “increased over time as new and riskier technologies have been developed to extract ore from less concentrated seams” (Urkidi, 2010, p.219). The impact increases further due to international interest in gold and due “to the legal reforms that attract mining investment” in Latin America (Urkidi, 2010, p.219). In the last decade, some of the biggest investments in mining, and in gold mining, were made in this region. Some of the reasons for this include the instability of the Soviet Union and African continent, and “mining restrictions in Canada and the USA” (Urkidi, 2010, p. 220). The practice of extracting precious metals from Latin America for export to Europe, and now to North America echoes the region’s painful colonial past. This is all the more aggravating since gold mining is considered a largely useless luxury, with about 43% of mined gold goes to jewellery manufacturing, 7% to central banks, 40% to personal investment, and only 10% to technological uses. It is also considered an abusive industry; of 171 mining conflicts surveyed around the world, 40% were related to gold mining. Gold mining also creates astronomical environmental impacts by consuming great quantities of water, with an average gold mine consuming 3.6 billion liters of water per year, and creating 79 tonnes of waste per 1 ounce of gold (MISN, 2012).

The overarching international climate is that there are no international laws that govern mining projects around the globe. Instead there is a number of voluntary and self-enforced codes such as the “International Cyanide Management Code, the Equator Principles, the International Finance Corporation’s Performance Standards, the Natural Resource Charter and the United Nation’s ‘Ruggie Principles’” (Siegel, 2013. p.6). Furthermore, mining may be perceived as “an enclave industry with few lasting effects on local economies” (Heirdrich, 2013, p.1) in part because despite promises made, its employment impact on local communities does not surmount its other negative effects. There is also a perception that “most mining jobs go to foreigners or non-locals because they require highly specialized skills” (p.1). An analysis of 66 mines in operation under Canadian ownership, responsible for approximately 63,000 jobs across Latin America revealed that the mines employ “less than 1 per cent of the labour force in the host countries” (p.1). As mining sites across Latin America and in other regions continue to
import outside workers – amongst them Canadian-trained engineers or construction and trade help – tensions and potential conflict with unemployed community members can increase (Kirschke, 2013).

Another area of system breakdown is in the sustainability sector. Mining was unaddressed in the Rio conference agenda of 1992, in the voluntary action plan for sustainable development, and it was not included in post-war discussions of international environmental and development institutions (Siegel, 2013, p.8). Other sectors were in the path to conservation in this same period, but mining was not listed amongst them, and it did not gradually integrate “concerns about sustainability into [its] knowledge community” (Siegel, 2013, p.9); instead it has remained static.

Although this article’s arguments are based on a structural functionalist lens, there is also a heightened importance in using a critical perspective, especially when the field of resource extraction in Canada has a long and tumultuous history. From a functionalist point of view we can ask what the causes are that are making the mining system unhealthy. In order to do this it is important to contextualize the system or organism being analysed. The system is not neutral or ahistorical. When speaking specifically of the Canadian mining education curriculum, we must look back at the beginnings of colonial education.

Colonial and Positivist Education

Links can be made between current mining educational practices and issues of colonial education. As Canadian universities formed, they followed transmission paradigms, where education was primarily seen as the passing of information and ideologies from one sector of society to the other. Within this system, imperialists' epistemologies and ontologies functioned by thinking that they held dominion over inferior cultures and that their duties as governors were to bring “equal measure of freedom and civilization” to the subjects in their colonies (Willinsky, 1998, p. 96). It was perceived that there was a market potential of “civilized” consumers, and in order to achieve this, the aim of colonial education was to transform natives into colonial intermediaries, “turning schools into civil-service training institutions intended to support the administration of the empire” (Willinsky, 1998, p. 99). In its initial formulation, as a colony to a larger empire, Canada's education served the purposes of the empire, even though these purposes were masked under well-meaning goals of
civilization and training. Moving forward in time, postcolonial analysis details how “new forms of colonialism or postcolonialism appeared through the work of [international government organizations], multinational corporations, and trade agreements” after World War II, where “education is viewed as an economic investment designed to produce better workers to serve multinational corporations” (Spring, 2008, p.335).

The silent acceptance of the necessity of mining in mining education – and an apparent neutrality towards the topic – passively legitimizes the exploitation of resources in vulnerable communities through curriculum, even when instances of clear conflict, violence and physical harm are visible. The field of mining engineering should include a background and history of the colonial framework through which it is taught, and acknowledge “Western civilization’s relentless advance, and the scientific pursuit of the knowing division and conquest of nature” (Willinsky, 1998, p. 112).

Engineering education as science education is based on positivist epistemologies that structure and privilege specific knowledge and discount other types of knowledge (Howe, 2009). In positivistic science education, ideas of quantitative and qualitative are pitted against each other, much like ideas of facts versus values are also pitted against each other. As a result, in what Howe coins the new positivist orthodoxy, science frames itself as “unproblematic” and elevates itself above the “rhetorical fray” (Howe, 2009, p.435). Ethics, a field of inquiry where values and qualitative measures are taken into account, does not fit with ease in a positivist framework. Positivist knowledge construction and inquiry requires a view of a single reality that “operates according to a series of natural laws” and methods through which to discover this reality; predict it and control it, ultimately exploiting “nature for the putative advantage of personkind” (Lincoln, 1989, p.226).

**Engineering Education (and Ethics) in Canada**

It is perceived that the mining industry has less experience with sustainability and ethics training than “forestry, agronomy, or soil ecology...there is no mining equivalent, for example, of the Yale School of Forestry & Environmental Studies” (Siegel, 2013). This is essential when considering that “industrial activity by its very nature creates risks” (Cragg, 1995, p. 230) and when considering that many of the mining projects, especially gold projects by Canadian corporations are in the Global South, where there
are different knowledge systems and constructions of the “other” at play.

As an educational field that is growing in Canada, mining education should consider its ethical ramifications carefully. Although there was a period in which mining education in Canada was under threat (Daemen, 2004; Fiscor, 2012; Gertsch, 2001) three years after the 2008 recession, there were about 1,000 job openings at Canadian mines and only about 300 students expected to graduate from mining-related programs. Schools reacted to the market and added more mining programs to their roster (Dehaas, 2011). Across thirteen engineering disciplines rated by Maclean's magazine, mining or mineral engineering grew significantly from 2007 to 2011 by 54% in enrollment (Maclean’s, 2012). Programs in the field of mining and mineral engineering, training that is used in the “planning, preparation, design and construction of a mine, its facilities and the extraction of all metal and non-metallic materials” are offered at Dalhousie University (Halifax, NS), École Polytechnique (Montréal, QC), Laurentian University (Sudbury, ON), McGill University (Montréal, QC), Queen’s University (Kingston, ON), Université Laval (Québec, QC), University of Alberta (Edmonton, AB), University of British Columbia (Vancouver, BC), University of New Brunswick (Fredericton, NB), Université du Québec en Abitibi-Témiscamingue (Amos, QC) and the University of Toronto (Toronto, ON) (Explore for More, 2013). These universities offer undergraduate, graduate and certificate programs in mining engineering. Two universities have been selected for analysis in this paper as they are the only two mining engineering programs that were represented in the The Pan-Canadian Mining Research and Innovation Strategy: The University of British Columbia (UBC) and McGill University (Canadian Mining Innovation Council, 2008). Both UBC and McGill offer undergraduate programs in mining engineering.

Current Ethics in Engineering: Examples

The two curriculums were analysed in terms of the opportunities for students to engage in mining-related ethical classes in each program. McGill boasts to be the host of the oldest mining engineering program in Canada, which started in 1871 (McGill, 2013). Through its mining engineering co-op program that spans 149 credits, the university allows only 6 of those credits to fall under the “Impact of Technology and Society” or “Humanities and Social Sciences, Management Studies, and Law” categories where a list of choices spans from anthropology, biotechnology, economics, environment,
geography, and sociology. Out of these short lists, MIME 308 Social Impact of Technology (3 credits) is the only class offered through the Faculty of Engineering and the department of Mining and Materials Engineering that deals with ethics. Only one other course deals directly with ethics, ENVR 203 Knowledge, Ethics and Environment (3 credits), but it is offered by the McGill School of Environment (McGill, 2013).

Similarly in UBC, starting from their second year of studies, mining engineering students will need minimum 3 credits from the “Impact of technology on society” offerings and minimum 6 credits from the “Humanities and social sciences” electives. This means that out of 116 credits needed in their last 3 years of studies, only 9 will potentially relate to ethical dilemmas in their fields. Optional electives range from technology and society, technology and development, sustainability, economics, computers and society, forestry, geography, environmental history, international security etc. PHIL 435, Environmental Ethics is a course “philosophy majors and other students interested in learning about our ethical obligations to the environment”, the only one to directly talk about ethics (University of British Columbia, 2013). Although other courses offered as electives could indirectly touch on ethical issues, it is worrying that there is only one course offered that deals with the issue firsthand, and even more worrying that a student could go through their entire undergraduate degree without confronting critical ethical thinking in a structured course. It is clear that ethics selections are extremely limited in the scope of education for both McGill and UBC, and that students miss out on valuable dialogue that will affect the way they carry out their positions in the mining industry upon graduation.

The lack of courses offered that relate to ethics corresponds to the trends of Corporate Social Responsibility (CSR) in the mining industry. The trend in CSR started 30 years ago with “health and safety reporting, followed by environmental initiatives in the early 1990s...while human rights have only been prioritized in the last half-decade” (Kirschke, 2013, p.3). Advocates for mining education cite the “positive and ongoing contributions of mining to the high standard of living enjoyed in the western world” (Gertsch, 2001, p.57), effectively ignoring the consequences that standard of living may have on non-westernized societies or communities where mining occurs. Some arguments for mining education lament the environmental movement’s political power and it might impede further mine development and reduce the number of positions in the mining industry (Daemen, 2004).

Others call for the support of industry in making Canadian mining engineers more
competitive by increasing involvement in training and in co-operative opportunities for students (Canadian Mining Innovation Council, 2008). For some advocates, mining is “an industry teeming with individuals who journey great distances to obscure places where risk and innovation collide head-on-all inspired by the idea that there is no challenge that technical or engineering solutions can't handle” (Kirschke, 2013, p. 30). However this view ignores that the professionals who journey great distances are travelling to someone’s land and to other’s homes, and are misinformed by the idea “that there is no challenge that technical or engineering solutions can't handle” (Kirschke, 2013, p. 30), excusing themselves from examining their presence there critically. Few, if any, advocates for the mining industry and mining education call for the advancement of ethics in training engineers or other mining professionals to promote the Canadian mining brand.

The lack of concern around ethics training is a disservice to the industry since “an industrial mine requires many things to make the business work. It needs top geologists, geochemists, mining engineers, trained labor, expensive machinery, roads, security, and complex chemicals” (Siegel, 2013, p. 5). A mining site is not only made up of miners, but of a high number of professional engineers. If these members of society are not educated in a way that allows them to be critical and responsible of their projects, then society is unhealthy, both here in Canada and also globally. It’s important to acknowledge however, that the changes needed are more than just in the education realm, and are part of structural issues much larger than a few university programs. However, increasing ethics options for students it is still an important endeavour to try to make every aspect of our society more responsible, and to try to create critical global citizens though higher education.

**Recommendations**

How are students of mining engineering to feel, to engage critically, and to take on other viewpoints when their very faculties do not seem to concern themselves with ethical training or discussions? A study of Korean science and engineering students assessed their “experience with the ethics education in science and technology studies and the perception of research ethics” (Song, 2010, p.175). Participating students had “strong beliefs on the necessity of ethics education compared to the amount of ethics education students had” (p.195). The study further suggests that “ethics education for
students in science and engineering should deal with practical knowledge rooted from the actual situation in laboratories and research setting” (p. 196). A similar study may be valuable in Canada.

Students in mining engineering programs should be faced with ethics-related issues specific to their field such as learning the morals of bargaining fairly, allowing communities voluntary choice, understanding what is informed and free consent, and conscientiously identifying involuntary stakeholders (Cragg, 1995, p. 230). Siegel states that conflicts in mining are not due to a lack of transparency or lack of Corporate Social Responsibility policies. Conflicts are due to the fact that resources are scarce and non-renewable. Ethical mining practice would include limits on prolonged extraction once the “grade reaches an unsustainable level in the area, rather than continuing to expand as if the resource were infinite” (Siegel, 2013, p. 17).

There are a number of important topics of ethic training that should be mandated as part of engineering accreditation, especially concerning mining engineering which may take place outside Canadian borders and in countries with more lax environmental and social regulations. Serious consideration needs to be given to the context in which mining engineering professionals will be working, especially regarding:

- The implications of their work on what is called “involuntary stakeholders”, which refers to the affected communities at mine sites.
- The historical roots of engineering education and the historical context in which it emerged.
- Critical reflection on positivist assumptions of the world, people, cultures and the resources. Considering the past trends, the context in which mining engineers will likely be working is Latin America, and potentially in remote communities where worldviews will vary vastly from those of the mining companies and employees.
- The de-colonizing of certain engineering educational mentalities which may be in conflict with current and future ethical training in the field.
- The connections between mining conflicts and their concurrent classes.
- The necessity of some materials that are mined, and balancing the importance of a resource and the stakeholders affected by its extraction, especially when looking at the apparent unnecessary extraction of gold.
- Other factors needed for ethics to be upheld in the mining sector besides more ethics education: why is the system unhealthy, and why is it malfunctioning.
Lastly, it seems as though university programs such as those at UBC and McGill rely on other university departments to impart ethics education and allow students to select their own ethics training through complementary electives. The missing opportunity in this choice is that students miss out on discussions about the ethical impacts of large resource extraction projects and the roles of engineers within these projects. A more direct approach that includes mandated ethics classes within the engineering department would be more useful and appropriate.

Conclusion

The Canadian government and mining industry have a vested interest in the reputation of Canada's mining brand and international competition. A responsible perception of Canada's mining professionals starts with proper education and increased ethics training. Through a structural functional, critical and world systems approach to mining engineering education and the context in which it operates, a conclusion can be drawn that the current state of ethics training in this field needs revaluation and reform. Especially when considering the impact of gold mining in Latin America, and the repercussions this has for affected communities, the arguments for increased ethics training need to be further considered. Of course any educational reform must be accompanied by social, political and economic factors that will facilitate its success, and the suggestions above are no exception. But it is not necessary to wait for all the factors to align. It is important to make improvements in the way the mining engineers of tomorrow will view their work, the world, their industry and their education.
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