

Green Growth for achieving education and technology transformation in the mining industry

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Abstract. Green growth has emerged as an important means by which developing countries may achieve sustainable development. It means that fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies. This study aims to elaborate the economic growth and enhance the synergy between environment, education, economy, and technology. Those parameters are linkage with the roles of the mining industry. The study method is focused on literature review by extracting the information on green growth, technology, education, and mining. The study found that sustainable economic growth achieved through green environmental technologies to maintain and restore environmental quality and ecological integrity while meeting human needs with the lowest possible environmental impacts. In addition, the mining industry contributes significantly to the economy and "Greening" the engineering curriculum is an important consideration for sustainable engineering education from fundamentals to design in the 21st century. The engineering curriculum integrates green engineering concepts horizontally and vertically by taking existing courses and integrating topics as appropriate through examples, problems and case studies. On the other hand, the mining industry is moving towards digitization and digitalization. The digital evolution creates the opportunity for the mining industry, it can change the business model, reducing costs in the value of chain, improving safety and creating opportunities for new business.

1. Introduction

Twenty years after the first Rio Conference on Sustainable Development in 2012, the world continues to face a twin challenge; expanding economic opportunities for all in the context of a growing global population and addressing environmental pressures that, if left undressed, could undermine our ability to seize these opportunities. Green growth is where these two challenges meet, and it is about exploiting the opportunities to realize the two together. Green growth means fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies. The focus of green growth strategies is to ensure that natural assets can deliver their full economic potential on a sustainable basis. That potential includes the provision of critical life support services – clean air, water and the resilient biodiversity required to support food production and human health.

Green growth has emerged as a central theme nowadays. It becomes a dominant response for serious warnings about climate change and ecological breakdown. As a theory, green growth asserts that



continued economic expansion, measured by Gross Domestic Product (GDP) which made compatible with our planet's ecology. Green growth policies provide strategies to overcome the economic policies which have a devastating impact on the sustainability of the country growth pattern. The growth that sustains development and increases the opportunities for jobs and income with low environmental degradations. Sustainable economic growth is achieved through green environmental technologies to maintain and restore environmental quality and ecological integrity while meeting the requirements of human needs with the lowest possible environmental impacts. It is a strategy that can maximize economic output (GDP) while minimizing the ecological burden. United Nations Economic Social Commission for Asia and Pacific (UNESCAP) in its paper on green growth based green growth on five tracks namely (1) green tax and budget reform; (2) development of sustainable infrastructure; (3) economic efficiency indicators; (4) promotion of sustainable consumption and production; (5) greening the market and business. One of the basic purposes of green growth is to facilitate green accounting; economists view that there is a need for GDP measuring to include green accounting as the existing national income accounts exclude environment. Green growth involves maximizing synergies between environmental, social, education and economic development outcomes and managing the costs, trade-offs, and uncertainties. Building on decades of research into sustainable development, Green growth emphasizes economic growth as a driver of increased welfare and how environmental issues will influence core development outcomes.

Growth has come at the expense of the environment, while environmental degradation affects everyone; the poor are more vulnerable to violent weather, floods, and a changing climate. Green growth or sustainable growth is a powerful tool to fight dangerous levels of climate change which can affect our environment. Green growth focuses on the synergies and trade-offs between the environmental and economic pillars of sustainable development. In other words, green growth discards the traditional convention of "grow first", clean up later" and discourages investment decisions that entrench communities and countries in environmentally damaging, carbon-intensive systems. Rather, it seeks to spur investment and innovation in ways that rise to new more sustainable sources of growth. Many mining companies have been operating the same way for decades. They must become a fully digitalized organization to keep pace with technology-driven performance improvement. Educational sustainable development bridges academic institutions and the needs of the community to enact sustainability in higher education, to positively affect the larger society and biosphere [1]. Technology conserves and protects the environment and minimizes the adverse impacts on the environment, improves economic development through technology and innovation. It includes all tools, machines, instruments, clothing, communication, and skills used to produce new things and meaningful development.

The mining industry has been facing many difficulties in the past few years. One of the challenges is the skills shortage in the mining sector. This is worsened by the recent labor unrest and lay off of workers. Stella Carthy, Head of Skill Development at the Chamber of Mines (CoM) reported in early 2012 that the skills shortage is not a shortage in the number of workers but rather the number of skilled workers, despite the training they received. It needs the use of technology to capture expertise and deliver it to a large number of learners is a clever way of addressing the shortage, despite the significant investment needed [2].

2. Method

This study uses literature review method to obtain the information and data associated with green growth, technology, education, and mining. Those keywords were used to search related available database on the internet. Elaboration on that information and parameters was conducted by using a qualitative method. The linkage between those parameters was also further analyzed to obtain a robust conclusion on the effect of green growth and education to the mining industry.

3. Result and Discussion

This section focuses on the three main critical issues, namely green growth, education and technological transformation in the mining industry.

3.1 Green Growth

There are three major institutional proponents of green growth theory at the international level: the OECD, the United Nations Environment Program (UNEP), and the World Bank, each published reports on green growth around the time of Rio+ Conference. The OECD defines it as “fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies.” The World Bank defines it as “economic growth that is efficient in its use of natural resources, clean in that it minimizes pollution and environmental impacts and resilient in that it accounts for natural hazards and the role of environmental management and natural capital in preventing physical disasters”. UNEP stated green growth as “one of simultaneously grows, income and improves human well-being while significantly reducing environmental risks and ecological scarcities.”

3.2 Education transformation in the mining industry

The current global energy and environmental crisis, the possible impact it might make on future generations. The fact that energy demand is increasing and the oil price has risen steadily has brought the demand for more efficient buildings, homes, cars, and consumer products to the front. Higher education has a critical role to play in producing sustainable students by helping them to understand “the complex connection and interdependencies between the environment, energy sources and the economy” [3] [4]. Education is required to accomplish this new way of thinking and learning about integrated, systemic solutions not just to the economic and environmental challenges but also the interdependent health, social and political challenges. This new way of thinking uses the green economy as the point for understanding the deep connections between economics, energy, environment and social. It is often referred to as sustainability.

Universities, in particular, have a responsibility to create space for alternative thinking and the emergence of new ideas as well as to explore the old ones critically. Higher education must appreciate and utilize differences among students because social interaction allows them to relate their ideas which may lead them to rethink of their ideas with alternative and contesting viewpoints. Learning experiences shared with others are likely to gain importance, giving the learners a sense of competence and belonging to the community of learners [3]. Universities are considered to have three major missions such as teaching, research and community services. They still serve this role in modern society although traditionally universities were predominantly for the elite, they can be valuable if they are also involved in community services. Universities are therefore tasked to critically engage with values to produce students who can play a role in seeking solutions for social problems. As mentioned in [5] that sustainability issue in education in universities worldwide are summarized as follow; (a) The impact of the environment should be the primary concern in all university decision making processes and students should be part of this program; (b) An environmental management system provides important opportunities for lecturers and students to engage with issues on sustainability; (c) A university that follows an environmentally friendly path enhances its public image, attracts and retains committed staff and reduces consumption and therefore saves money; (d) Including environmental issues in existing qualifications as well as having distinct qualifications in which the content is uniquely environmental and sustainable is a better approach as lecturers will not feel as if they are working beyond the parameters of their disciplines.

Furthermore, [5] explained that the concept of resilience is increasingly being used in sustainable development. Educational spaces should build a culture of learning with uncertainty and in which uncertainty provokes transformative yet precautionary commitment rather than paralysis. A resilient problem-solving student can become an employable graduate who is also an asset to his community. Higher education contributes to the formation and development of human capital, the culture and social construction of values and meaning and the capacity for individual and collective emancipation from ignorance to domination. The demand for sustainability has created new careers in the green industry and the greening of all other employment from construction to business management. Four institutional criteria for high performance in sustainability were suggested by [5] [6], namely (1) infusion of green

concepts in the curriculum; (2) focus on workforce development and green jobs; (3) research and development related to re-enable energies; and (4) promotion of environmental principles in the operations and facility management of the institutions.

The need to introduce green engineering concepts to undergraduate students has become recognized to be increasingly important, students must be prepared for engineering practice through the curriculum culminating in a major design experience, incorporating engineering standards and realistic constraints that include economic, environmental, sustainability, manufacturability, ethical, health, and safety, social and political. Discipline-specific criteria such as in chemical engineering, further specify that engineers must have "safety and environmental aspects" included in the curriculum to achieve a sustainable future. A better method is to introduce these concepts throughout the curriculum. This would better emphasize that engineers should be using green engineering and sustainability throughout the design process. This approach shows the high importance of this subject to the students and reinforces the need to employ this subject in the industry. The faculty may agree to add this material, but its coverage becomes diluted and sporadic throughout the curriculum, which reduces the importance of this subject in the students' mind. Efforts are currently underway to integrate green engineering concepts throughout the curriculum. These efforts include the development of instructor guides, case studies, homework problems, and in-class examples. The need to introduce environmental engineering or green engineering design for the environment concepts to undergraduate engineering students has become recognized to be increasingly important [7] and is required by ABET criteria 2000. Accreditation Board for Engineering and Technology (ABET) criteria 2000 further requires the integration and implementation of a broad education to understand the impact of engineering solutions in a global context. The classes of engineering should be designed to stimulate students interests in multidisciplinary open-ended challenging engineering projects which are mainly research or industry-sponsored. E-learning is already being used, it has the potential to liberate, educate and transform learners. However, the complexity of implementing e-learning should not be underestimated. [8] noted that to be effective, implementing e-learning in the mining industry needs to take into account external influences, existing corporate goals, learner needs, and support processes.

E-learning can be a great tool to help employees up-skill quickly and ensure that there is a seamless introduction to these new company policies. There are reasons for e-learning in the mining industry (1) maximizing production and minimizing costs, and e-learning will prove to be the most productive and cost-effective solution for this pressured environment; (2) measurable progress, e-learning offers the finite measurement of company's training. Each employee's training experiences and progress can be tracked, therefore becoming invaluable in recognizing vocational blind spots and fostering comprehensive learning practices that improve production efficiency, health and safety; (3) consistent content, e-learning offers a sustainable and consistent solution. No matter the location of the learners, they are provided with the same content; (4) distance learning, it becomes more desirable, the learners can learn and be assessed no matter where in the world they might find themselves; (5) effective costs, e-learning program have become more competitively priced. Also, the long term benefits of e-learning can be demonstrated easily. The reduction in personnel costs and increase company return on investment makes e-learning a more attractive option.

3.3 Technological transformation in the mining industry

Green technology is the development and application of products, equipment, and system used to conserve the natural environment and resources which minimize and reduce the negative impact of human activities. Green technology refers to following criteria like minimizing the degradation of the environment, zero or low greenhouse gas (GHG) emission is safe for use and promotes a healthy and improved environment for all forms of life, conserves the use of energy and natural resources and promotes the use of renewable resources. The green technology important cannot be ignored, the goals of green technology are to meet the needs of society without damage or deplete natural resources on earth. Focus is being shifted on making products that can be fully reclaimed or re-used. By changing

patterns of production and consumption, steps are being taken to reduce waste and pollution, as one of the important goals of green technology.

New mining technology and regulation have significantly improved mining efficiency and reduced environmental impact in recent years. In general, mining techniques become more environmentally sensitive when efficiency is improved because less waste is produced. The plan for improving efficiency and decreasing the environmental impact is broken up into the following categories: shutting down illegal and unregulated mines; choosing environmentally friendly general mining processes; implementing recently discovered green mining technologies; cleaning up the site of shut down mines; re-evaluating cut-off grades; and research & development of green mining technology. Two major methods of implementing green mining reform are governmental regulation and innovative technologies. Better regulation generally precedes cleaner mining practices, these recent technologies include (a) mining from tailings, sometimes amounts of the metal being mined up in the wastes, reprocessing these wastes can result in more usable material; (b) liquid membrane emulsion technology, this is separation technique that can be used to extract usable metal from highly toxic or acidic wastewater produced by a mine. This technology can even deal with dilute solutions; (c) dust suppression techniques, during the mining process, large amounts of dust are released into the atmosphere. This can be minimized by pre-wetting the areas to be blasted with high volume sprinklers. Once the dust is in the air, the only way to remove it is through mist cannons. Current mines using open-pit mining techniques can reduce dust through by purchasing high volume sprinklers and wet Earth Fog Cannons. It would be unreasonable to expect all strategic mineral mines to adopt every one of these mining technologies.

4. Conclusion

Greening the mining sector can be an opportunity to introduce environmentally sensitive technologies and practices to reduce environmental impact while supporting the growth of new green industries. Going green is about knowledge-based utilization of God's nature material gift for our sustainability and preservation using environmentally friendly technology and processes. Environmental technology is perceived as an important source of reducing the emission and improving the efficiency in the market. Green environment technologies focus on the innovation that resultants in minimizing the degradation of the environment. The use of clean technology will have an incredibly positive impact not only on the health and safety performance of the mine but also on its environmental footprint. Technology can potentially decrease the environmental and health impact of mines through more efficient resource use, safer mine sites and better control of pollutants. Necessity has placed on us the role to promote green education to ensure the survivability of the national economy and ourselves in particular. Universities should rethink their way of designing curriculum, not look at content first and not view existing study material as sufficient to cut and paste into a curriculum of the 21st century.

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