Green skills for electrical engineering students

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Abstract. Green skills are the knowledge, skills, abilities, values, and attitudes needed to develop and support efforts to reduce the impact of human activities on the environment for the realization of social, economic and survival. This study aims to identify green skills especially for electrical engineering students and why this is important. In this study literature studies were conducted with documents and articles sought in electronic databases such as Academia, Elsevier, Emeraldinsight, Google Scholar, ResearchGate, and ScienceDirect. The findings from the results of this literature study reveal that the importance of green skills for electrical engineering is inseparable because the demand for labor in the renewable energy sector reached 10.35 million in 2017, up 5.3% from the previous year and predicted to continue to rise in the following years. The ability such as renewable energy skill and energy efficiency skill are some of the green skills that are suitable for electrical engineering students. To developing green skills, require effort such as developing a curriculum that is oriented towards environmental sustainability and with the integration of environmental sustainability content through problem-based learning.

1. Introduction
Environmental issues become a matter that and continues to be considered and developed [1] even today. This issue happens because of continuous environmental changes that we can also feel. Environmental conditions can be maintained well if everyone has more attention to his or her environment [2]. One effort to keep environmental resilience is to understand and practice green skills. Green skills are the knowledge, skills, abilities, values, and attitudes needed to develop and support efforts to reduce the impact of human activities on the environment for the realization of social, economic and survival [3].

Green skills implementation also provides other benefits; this is because in the development of the green economy the demand for workers with this skill is quite high [4]. For example, the State of Australia in November 2009 signed a Green Skills Agreement (GSA). With the implementation of this agreement, training in the development of green skills is deemed necessary in the education system to produce graduates needed by industry [5]. The Australian Government has also changed policies in developing renewable energy and industrial growth related to green technology and green skills. Some countries have also made green technology the basis for development and energy sustainability [6-8].

As one of the essential parts in a green economy, green energy or renewable energy is one sector with a high demand for labor [9], the industry requires a lot of labor for most renewable energy programs such as energy efficiency, smart measurement and renewable energy production [10]. This is also inseparable because the elements of energy efficiency and effectiveness are essential in achieving sustainable development goals into the future [11,12]. Opportunities in the field of green energy should
be able to be appropriately utilized, especially for electrical engineering students who can later contribute to the development and utilization of energy that is more environmentally friendly.

Researchers in this paper will compile literature related to the topic of the study and provide views in the form of summaries. The results of the study will be needed to identify green skills specifically for electrical engineering students and why this is important.

2. Green skills for green economy

Green economy is a very complex construction regarding efforts to integrate economic, environmental and social problems, which involve various figures and forms of government needed to regulate the process of greening the economy [13]. While currently the economic model is dominated by a system that produces extensive environmental and health risks, encourages wasteful consumption and production, stimulates ecological and resource scarcity and produces inequality [14]. Green economy is a solution and an opportunity to advance sustainability and social justice as a function of a more stable and prosperous system [14]. The vocational education and training system can equip all individuals with the competencies needed to fully utilize the opportunities generated by the green economy [15].

The development of green economy also affects the types of jobs that change due to the emergence of new technologies and equipment. Work in the green economy must also be "green" and feasible [16]. In order to realize the green economy, workers who have the ability and skills are needed to support the running of this economic system. Following is a summary of skills requirements for a green economy.

| Skills for a green economy | Skills needs |
|---------------------------|-------------|
| Skills supporting resource efficiency | All businesses need generic or light green skills including: |
| | • Strategic business management to build resource-efficient business models leading to bottom-line benefits and in preparation for new regulations. |
| | • Business/financial accounting services around carbon and natural environment accounting. |
| | • Skills to design and adopt technologies, products, and processes increasing resource efficiency, including lean manufacturing. |
| | • Project management skills with clear understanding of resource efficiency. |
| | • Operator level actions to maximize resource efficiency (e.g., reducing waste in production). |
| Skills supporting low carbon industry | Low carbon industry focuses on energy generation and production with high energy requirements. Skills include: |
| | • Scientists and engineers with training or transferable knowledge for nuclear and renewable energy (including wind and marine) |
| | • Technicians with training or transferable knowledge to install energy efficiency measures and retrofit at a household and business premises level. |
| | • Skills to design and adopt technologies, products, and processes to minimize carbon emissions. |
| | • Operator level actions to minimize carbon emissions |
| Skills supporting climate resilience | Business requires the capacity to adapt to changes in climate. The necessary skills include: |
| | • Scientific and technical skills such as modeling and interpreting climate change projections |
| | • Risk management such as assessments of future resource availability |
| | • Skills to design and adopt technologies, products, and processes to improve climate resilience |
| | • Operator level actions to improve climate resilience (e.g., retrofitting water efficient technologies in households and business premises). |
| Skills to manage natural assets | Natural assets underpin all business practice. Skills to protect and manage them include: |
| | • Accounting services for the natural environment |
| | • Understanding of environmental impact assessments |
| | • Understanding and interpretation of environmental legislation targets, ecosystem services design and management and land use planning |
| | • Skills to design and adopt technologies, products, and processes to manage natural assets. |
Some skills also play a role in the transition towards the green economy, the skills to support innovation and adaptability are as important as technical skills, because the industry will gradually adapt to the need to utilize resources [18] better. This means that transversal and industry (and technical) skills will be needed. About transversal skills, four main categories can be observed. First of all, technological skills will be required (for example in research or engineering). Second, management skills and technical knowledge are needed (for example to be more energy efficient, reduce generation and pollution). Third, skills in innovation and management for change, especially communication skills, are needed. Finally, "transversal generic skills" are required, which must support the overall transition of workers in various industries [18]. Green skills are needed for the successful transition to a low-carbon economy and maximizing the potential of human resources to achieve these goals [19].

Green skills emerged along with more "green" economic growth which was also triggered due to the awareness of achieving a resilient, low-carbon, and resource-saving economic model that led to a higher quality of life and improved welfare. Green skills are the knowledge, skills, abilities, values, and attitudes needed to develop and support efforts to reduce the impact of human activities on the environment for the realization of social, economic and survival [20]. Green skills are also defined as a set of efficiencies related to the design, output, management, and monitoring of technology that is triggered because of the rules of environmental change in technology and organizations that increase the demand for higher analytical and technical skills [21]. If viewed from the cognitive aspect, Green skills refers to knowledge about protection of the environment, while from psychomotor aspects, Green skills refers to the ability to act such as minimizing energy consumption, or reducing greenhouse gases, and from the practical perspective, green skills refers to attitudes, for example, self-motivation to preserve natural resources [14].

Skills that have been formulated and included in green skills include; 1) Awareness, attitude, and readiness to study the problems and challenges of sustainable development; 2) coordination and management of holistic skills approaching solutions that are designated to meet economic, social and ecological goals; 3) Entrepreneurial skills to seize opportunities from low-carbon technology; 4) Innovation skills to identify changes and create new strategies to respond to the challenges of sustainable development, 5) STEM skills: general knowledge about the role of science, technology, engineering, and mathematics to contribute to more environmentally friendly economic processes and societies, 6) Ability to think analytically: As a step in business and industry towards a genuinely sustainable model [22].

3. Green skills for green energy
The economic movement towards a green economy creates opportunities for technology, investment, and new jobs. At the same time, environmental changes and especially climate change have a detrimental effect on specific economic sectors and can cause loss of some jobs. Lack of professionals with cutting-edge skills in energy efficiency, green engineering, and green construction have been identified in some countries as the main obstacles in implementing national strategies to reduce greenhouse gas emissions or address environmental change [16].

Also, energy demand continues to increase which encourages industry players in this field to continue to work to recruit workers who can drive this business towards a better direction. Work that includes energy efficiency, renewable energy, waste reduction, conservation of natural resources and environmental education are some of the work needed [10] Jobs that include renewable energy can be classified into jobs related to fuel-free technology, such as wind power and photovoltaic solar [23].

The green energy sector produces more jobs per unit of energy channeled (per average MW) than the fossil fuel-based sector [24,25] Energy-saving investments in addition to saving costs also offer more jobs than the fuel-based sector, because the money saved is then free to spend in other economic areas [26].
4. Method

The step used to explore the importance of green skills for students majoring in electrical engineering is to do document analysis. Relevant documents are very important to be taken and reviewed. However, it is also impossible to get every article related to this study because some of them are not published and may not be searchable. In this study, documents were searched in electronic databases such as Academia, Elsevier, EmeraldInsight, Google Scholar, ResearchGate, and ScienceDirect with keywords such as environmental resilience, energy, renewable energy, energy security, green economy, green technology, green industry, green jobs, and green skills. With a total of documents in the form of journals and reports downloaded approximately 150 documents. As for the documents used in journal writing, there are 45 documents with details in table 2.

| Kata Kunci                              | Document |
|----------------------------------------|----------|
| Sustainability Environment, Sustainability Development | 15       |
| Energy, Renewable Energy, Sustainable Energy | 5        |
| Green Economy, Green Technology, Green Industry, Green Energy | 8        |
| Green Jobs, Green skills                | 9        |
| **Total**                              | **28**   |

The searching of documents and articles with keywords and objectives; 1) Environmental resilience with the keywords "sustainability environment, sustainability development," documents and articles related to environmental resilience are needed to find problems related to the impact of human life activities on the environment and efforts in maintaining the environment. 2) Energy, renewable energy and energy sustainability, with the keywords "energy, renewable energy, sustainable energy," documents and articles relating to renewable and sustainable energy are needed to find the extent of the impact and importance of energy development, both in friendly energy generation technology environment and energy use. 3) The green concept, with the keywords "green economy or green technology or green jobs or Green skills," documents and articles related to green concepts as the primary study material are needed to find information about the description of the green economy, green technology, green industry, green jobs, and Green skills.

5. Results and discussion

This discussion will review several subtopics regarding green skills for electrical engineering students which include: 5.1) the number of job opportunities for graduates of electrical engineering in the renewable energy sector, 5.2) Green skills needed by electrical engineering students, and 5.3) the development of green skills for electrical engineering students.

5.1. The number of job opportunities for graduates in electrical engineering in the renewable energy sector

This discussion will review employment opportunities in the field of renewable energy which is one reason why electrical engineering students need to master green skills. The amount of employment opportunities in the renewable energy sector is inseparable from the magnitude of the desire and commitment of several world countries to produce environmentally friendly energy. In 2017 there are around 10.35 million people worldwide working in the renewable energy sector and up 5.3% from the previous year [23]. The most significant number of workers is in China, which is 43% of total employment in the world renewable energy sector. Jobs in the energy sector are also expected to continue to increase in the future [23]. The data below shows the number of jobs in renewable energy in the world in 2017.
Table 3. Number of jobs in world renewable energy [23].

| Energy Sector       | The number of workers |
|---------------------|-----------------------|
| Hydro Power         | 1.51 Million          |
| Solar Photovoltaic  | 3.37 Million          |
| BioEnergy           | 3.06 Million          |
| Wind Energy         | 1.15 Million          |
| Other Energy Sector | 1.26 Million          |
| **Totals**          | **10.35 Million**     |

Some studies also show that employment opportunities for the electricity sector will increase, especially in the field of renewable energy or also often referred to as green energy. Increased work in this field has even occurred in previous years, a study of renewable energy in 2008, proving that the work of renewable energy technologies is around 2.3 million jobs worldwide [27]. While other studies project that by 2020 renewable energy can employ two million citizens in Europe [28], investment in renewable energy is encouraged and supported by the European Union and member countries and will have a positive impact on employment until 2030 [29]. 30% of electricity from renewable energy, each of which can produce around 2 million years of work in the United States in 2030 [25].

The data below shows occupation in the field of renewable energy which may be occupied by graduates of electrical engineering.

Table 4. Occupation in renewable energy [30].

| Areas of Employment | Job Opportunities                                      |
|---------------------|--------------------------------------------------------|
| Rural Electrification | Sales/planning/project engineers                        |
|                     | RE Technicians/Installers/Repairmen                     |
|                     | Community Organizers                                    |
|                     | RE Resource Assessors                                    |
|                     | RE Component Fabricators                                 |
|                     | Village Electricians                                     |
|                     | Micro-Financiers                                         |
|                     | RE Project Monitors                                      |
| Industry            | Energy Managers                                          |
|                     | Energy Auditors                                          |
|                     | RE Planners/Engineers/Researchers                        |
| Manufacturing       | Designers/Engineers/Draftsmen                            |
|                     | Metal workers/Tinsmith/Welders                           |
|                     | Electricians                                             |
|                     | Mechanics                                                |
| Government          | Energy Managers/Officers                                 |
|                     | Energy Auditors                                          |
|                     | RE Planners/Engineers/Researchers                        |
|                     | RE Technicians/Inspectors                                |
|                     | Rural Development Officers                               |
|                     | Community Organizers                                     |
|                     | Trainers                                                |
| Academe             | RE Professors/Teachers                                   |
|                     | Researchers                                              |
|                     | Trainers                                                |
| Livelihood\ Agriculture | RE Technicians                           |
|                     | Mechanics, Electricians, Welders                         |
|                     | Researchers                                              |

Refer to table 4; there are indeed quite some types of work that can be filled by graduates of electrical engineering even though there are also some that are not appropriate. This opportunity is indeed a positive side for students or graduates in electrical engineering because they will get so many job opportunities in the renewable energy sector.
5.2. Green skills for electrical engineering students
A large number of employment opportunities in the field of renewable energy should be appropriately utilized by electrical engineering students. With proper engineering skills and green skills, they will play an important role in improving the quality of work and the environment [4]. Even when at the level of engineers, they must also learn to think long-term and position their activities on the path to sustainable solutions [31-33] because the sustainability concept that exists on green skills can also be a significant factor for innovation, both in economic action or employment and in education [34].

Specific studies on green skills, especially those needed for the energy sector, are not many. The conceptualization of competencies for sustainable development where green skills are included also has very complex characteristics [35] The limitations of information and data about green skills make the author only take one of the lists of green skills that have been developed by the British Government. In the green skills list, there are ten skill groups (Tier 1), which are broken down into general skills categories (Tier 2) and more specific skills (Tier 3). In the following table, only one group of green skills is presented, namely in the energy sector which is the most appropriate part of the electrical engineering field.

Table 5. Green Skills in the energy sector [4].

| Tier 1                          | Tier 2                                                                 | Tier 3                                                                 |
|---------------------------------|------------------------------------------------------------------------|------------------------------------------------------------------------|
| Energy minimization             | Energy reduction programmes, heat recovery and re-use, energy efficient technologies, energy-efficient practices, communications/implementation campaigns, enhanced capital allowance technologies and schemes |
| Energy management systems       | Objective setting, legislative and regulatory compliance, energy base loads and variable loads, energy audit, energy review, communications/implementation campaigns |
| Energy quantification and monitoring | Monitoring targeting and reporting, use of half-hourly data, use of sub-meters, computer-based data logging and energy management systems, energy data manipulation software systems |
| Energy costs and trading        | Energy markets and pricing, carbon trading schemes, climate change levy agreements, energy price trends, enhanced capital allowances, peak oil and impact on energy supplies and prices |
| Renewable energy (RE) technologies | Solar, wind, biomass, combined heat and power, photovoltaic, ground source heat pump, air source heat pump, hydro, hydrogen, fuel cell, integration into energy supply |
| Non-renewable technologies      | Nuclear, incineration with energy recovery, clean fossil fuel technologies, carbon sequestration, waste-to-energy |

Refer to table 5, the list of green skills above it can be seen that the ability of green skills is indeed quite broad. Therefore, these abilities may not all have to be mastered, but some abilities can be learned more deeply following the needs and fields that will be more in demand. Green skills themselves will be needed for electrical engineering students to develop affordable and more environmentally friendly electrical energy sources and how they can become agents of change in a wiser use of energy.

5.3. Development of green skills for electrical engineering students
Green skills can be developed through curriculum development, education, training, teaching and learning, and can also provide green skills training to trainers of technical and vocational education [36]. The aim is to produce workers who are competent and able to contribute to environmental preservation [2] Green skills are also needed in the efforts of educational institutions to respond to the emergence of demands for new skills along with the development of a green economy [37] because the green skills training system must also adapt to the needs of the industry [38,39].

Efforts to develop education for environmental sustainability have been carried out by one of the world's organizations, Commonwealth, by forming a curriculum framework. The following is one of the
curriculum frameworks that can be developed for vocational education (TVET) which is oriented towards affordable and clean energy.

Table 6. The curriculum framework that can be developed for TVET which is oriented towards affordable and clean energy [40].

| Knowledge and understanding | Skills and applications | Values and attitudes |
|-----------------------------|------------------------|---------------------|
| • Different types of energy, with a focus on renewable energy. | • Energy and environmental management, auditing, design and implementation of sustainable energy transitions. | • Increased awareness of the need for sustainable energy production. |
| • Renewable energy infrastructure and technologies, and energy efficiencies. | • Promotion of improved energy conservation and uptake of renewables. | • Ethical awareness pertaining to energy production and consumption. |
| • Research into green trade opportunities. | • Green and renewable energy skills, application of renewable energy technologies. | • Environmental consciousness and advocacy for mainstream change. |
| • Highlight the link between energy and climate change, mitigation and adaptive strategies. |

The development of the curriculum framework is the first step that needs support from all parties. This is because even though sustainability content is part of the educational curriculum the opportunities for students to be involved in environmental problems in the community are still lacking [41,42]. Also, environmental, social and institutional factors can also influence the results of increasing understanding of environmental sustainability in technical education [43,44]. Therefore, in the development of green skills for electrical engineering in addition to incorporating environmental sustainability content into the curriculum as well as renewable energy efforts are also needed in its strengthening. This strengthening can be done by educational institutions through extracurricular activities as well as from the participation of people around the neighborhood. Educational institutions should also not only develop skills to increase income but skills to improve life [15].

Whereas regarding learning the concept of problem-based learning is one of the theories of learning that can integrate sustainability content. Through participatory and independent learning students can solve real problems, and independently identify education and personal needs, choose relevant knowledge, develop learning strategies and learn new knowledge [45]. It can also be through learning with problem-based inter-disciplinary approaches that are adapted to sustainability issues in a group or educational institution [46]. With good characterization, the application of problem-based learning can foster student awareness of the environment [47,48] one of which is about renewable energy and energy efficiency which is one of the green skills required by electrical engineering.

6. Conclusion
The importance of green skills for electrical engineering is inseparable due to job opportunities in the growing renewable energy sector. The use of renewable energy is also one of the ways humans maintain the earth's environment to remain in good condition. Therefore, jobs in this sector also require workers who have good engineering skills and even a concern for the environment.

The ability of renewable energy and energy efficiency are some of the green skills that are suitable for electro students. Electrical engineering students need this ability to develop affordable and more environmentally friendly electrical energy sources and how they can become agents in wiser energy utilization. To developing green skills, require effort such as developing a curriculum that is oriented towards environmental sustainability and with the integration of environmental sustainability content through problem-based learning.

References
[1] Martinez-Fernandez C, Hinojosa C and Miranda G 2010 Green Jobs and Skills: The Local Labor Market Implications of Addressing Climate Change. Working document (OECD)
[2] Kamis A, Rus R C, Rahim M B, Yunus F A N, Zakaria N and Affandi H M 2017 Exploring Green
Skills: A Study on The Implementation of Green Skills Among Secondary School Students

Int. J. Acad. Res. Bus. Soc. Sci. 7(12) 327-345

[3] OECD 2015 Green Skills and Innovation for Inclusive Growth Pub. Offi. Euro. Uni. (Cedefop)

[4] Strietska-Iлина O, Hofman C, Duran H M and Jeon S 2011 Skills for Green Jobs: A Global View. Synthesis report based on 21 country studies. Executive Summary

[5] McDonald G, Condon L and Riordan M 2012 The Australian Green Skills Agreement Policy and Industry Context, Institutional Response and Green Skills Delivery (Broadway, Australia: TAFE Directors Australia)

[6] Carbonel L G, Adora M B and Agbisit I C 2015 Global Environmental Issues Awareness and The Perceived Remedial Measures KASC Res. J. 387

[7] Hashim H and Ho W S 2011 Renewable energy policies and initiatives for a sustainable energy future in Malaysia Renew. Susta. Ener. Revi. 15(9) 4780-4787

[8] Lema R and Lema A 2012 Technology Transfer. The Rise Of China and India in Green Technology Sectors Inno. Dev. 2(1) 23-44

[9] Kammen D M, Kapadia K and Fripp M 2004 Putting Renewables to Work: How Many Jobs Can The Clean Energy Industry Generate

[10] IEA 2009 Ensuring Green Growth in a Time of Crisis; The Role of Energy Technology

[11] Adger W N, Arnell N W and Tompkins E L 2005 Successful adaptation to climate change across scales. Global environmental change 15(2) 77-86.

[12] Batterman S A, Martins A G, Antunes C H, Freire F and da Silva M G 2011 Development and Application of Competencies for Graduate Programs in Energy and Sustainability J. Prof. Issu. Eng. Educ. Prac. 137(4) 198-207

[13] Bailey I and Caprotti F 2014 The Green Economy: Functional Domains and Theoretical Directions of Inquiry Envir. Plan. 46(8) 1797-1813

[14] Setiawan A 2017 Identification of Green Skills acquisition in Indonesian TVET curricula AIP Conf Proc. Vol. 1887 No. 1 p. 020074

[15] Fien J and Guevara J R 2013 Skills for a Green Economy: Practice, Possibilities, and Prospects. In Skills Development For Inclusive And Sustainable Growth In Developing Asia-Pacific pp. 255-263

[16] ILO 2011 Skills And Occupational Needs in Renewable Energy

[17] Department for Business, Innovation & Skills 2011 Skills for a Green Economy: a Report on The Evidence (England:HM Government)

[18] OECD 2014 Job Creation and Local Economic Development (OECD Publishing)

[19] OECD 2014 Greener Skills and Jobs (OECD Publishing)

[20] OECD 2015 Green Skills and Innovation for Inclusive Growth (Luxembourg: Publications Office of the European Union)

[21] Vona F, Marin G, Consoli D and Popp D 2015 Green Skills No. w21116. Working Paper

[22] Pavlova M 2012 Generic Green Skills: Can They be Addressed Through Technology Education Vol. 2 49

[23] IRENA 2018 Renewable Energy and Jobs Annual Review 2018

[24] Stevens C 2009 Green Jobs and Women Workers: Employment, Equity, Equality (Madrid:International Labour Foundation for Sustainable Development). Draft Report

[25] Wei M, Patadia S and Kammen D M 2010 Putting Renewables and Energy Efficiency to Work: How Many Jobs Can The Clean Energy Industry Generate in The US 38(2) 919-931

[26] WWF 2011 The Energy Report: 100% Renewable Energy by 2050 (Switzerland:WWF)

[27] Edenhofer O, Pichs-Madruga R, Sokona Y, Seyboth K, Kadner S, Zwickel T, ... and Matschoss P 2011 Renewable Energy Sources and Climate Change Mitigation: Special Report of The Intergovernmental Panel on Climate Change

[28] EREC 2010 RE-thinking 2050: A 100% Renewable Energy Vision for the European Union

[29] Cambridge Econometrics, ICF GHK, IER 2011 Studies on Sustainability Issues: Green Jobs; Trade and Labor
[30] Romaquin K D, Riguer M G L, Peji B A, Tabladillo S and Alarde M A B 2008 Green Jobs: Working With Climate Change (Manila, Philippines: Institute for Labor Studies).
[31] Allenby B, Murphy C F, Allen D and Davidson C 2009 Sustainable Engineering Education in The United States Sustain. Sci. 4(1) 7–15.
[32] Mulder K F, Segalàs J and Ferrer-Balas D 2012 How To Educate Engineers for/in Sustainable Development: Ten Years of Discussion, Remaining Challenges. Int. J. Sustain. High. Educ. 13(3) 211-218.
[33] Glassey J and Haile S 2012 Sustainability in Chemical Engineering Curriculum. Int. J. Sustain. High. Educ. 13(4) 354-364.
[34] Fourati-Jamoussi F, Dubois M J, Agnès M, Leroux V and Sauvée L 2018 Sustainable Development as a Driver for Educational Innovation in Engineering School: The Case of Unilasalle Euro. J. Eng. Educ. 1-19.
[35] Mochizuki Y and Fadeeva Z 2010 Competencies for Sustainable Development and Sustainability: Significance and Challenges for ESD. Int. J. Sustain. High. Educ. 11(4) 391-403.
[36] Kamis A, Mustapha R, Wahab N A and Ismail B L H 2016 Green skills as an Added-Value Element in Producing Competent Students Int. J. Eng. Res. App. 6(11) 12-21.
[37] Jagannathan S 2013 Education and skills in Asia: Responding to Greening Economies in Skills Development for Inclusive and Sustainable Growth in Developing Asia-Pacific pp. 265-280 (Dordrecht: Springer).
[38] McCoy A P, O’Brien P, Novak V and Cavell M 2012 Toward Understanding Roles for Education and Training in Improving Green Jobs Skills Development Int. J. Cons. Educ. Res. 8(3) 186-203.
[39] Sern L C, Zaime A F and Foong L M 2018 Green Skills for Green Industry: A Review of Literature. J. Phy. Vol. 1019 No. 1 p. 012030.
[40] Osman A, Ladhani S, Findlater E and McKay V 2017 Curriculum Framework for the Sustainable Development Goals (Commonwealth Secretariat).
[41] Kennedy K J and Chow J K F 2013 Schooling’s contribution to a sustainable future in Asia: Can schools develop ‘green citizens. In Skills Development for Inclusive and Sustainable Growth in Developing Asia-Pacific pp. 345-365 (Dordrecht: Springer).
[42] Mukoni M 2013 Environmental Education in Zimbabwean Secondary Schools:’Greening Or Transformative Social Change Int. J. Asia Soc. Sci. 3(4) 971-991.
[43] Biswas W K 2012 The Importance Of Industrial Ecology in Engineering Education for Sustainable Development. Int. J. Sustain. High. Educ. 13(2) 119-132.
[44] Segalàs J, Mulder K F and Ferrer-Balas D 2012 What do EESD “experts” Think Sustainability is, Which Pedagogy is Suitable to Learn it. Results from interviews and Camps analysis gathered at EESD 2008 Int. J. Sustain. Higher Educ. 13(3) 293-304.
[45] Guerra A 2017 Integration of sustainability in Engineering Education: Why is PBL an Answer Int. J. Sustain. High. Educ. 18(3) 436-454.
[46] Dobson H E and Bland T C 2012 Creating sustainable development change agents through problem-based learning: Designing appropriate student PBL projects Int. J. Sustain. High. Educ. 13(3) 263-278.
[47] Wiek A, Xiong A, Brundiers K and van der Leeuw S 2014 Integrating Problem-and Project-Based Learning Into Sustainability Programs: a Case Study on The School of Sustainability at Arizona State University Int. J. Sustain. High. Educ. 15(4) 431-449.
[48] Fini E H, Awadallah F, Parast M M and Abu-Lebdeh T 2018 The Impact of Project-Based Learning on Improving Student Learning Outcomes of Sustainability Concepts in Transportation Engineering Courses Euro. J. Eng. Educ. 43(3) 473-488.