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Review on Alternative Energy Education in Malaysia

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ABSTRACT

Alternative energy sources have gained increasing attention due to the diminishing fossil fuel reserve. However, awareness of the importance and use of this alternative energy is still lacking in developing countries, especially in Malaysia. Alternative energy technology is also not widely known amongst students. Community awareness of the importance and usability of alternative energy to ensure the preservation of the earth and nature remains less due to the convenience of the community to existing power sources from fossil fuel. The dependence on fossil fuel has contributed to 40% of the carbon dioxide emission damaging the ecosystem and will undoubtedly have adverse effects in the future. Hence, replacing this energy source with alternative sources is necessary to preserve the environment. To increase public awareness regarding this issue, scholars should create an application that would be easily accessible to the society. This study aims to criticise public's awareness and challenges faced in educating the community on alternative energy. Society awareness is important in maintaining and preserving the environment because alternative energy sources are eco-friendly and produce less carbon dioxide than existing energy resources. This article also examines the development of education modules for students especially in Malaysia. Additionally, a curriculum oriented in higher education is recommended to produce a generation that loves nature and explores the environment with the development of science and technology. Comparisons of education systems among developed countries are helpful in achieving this objective.

Keywords: Alternative energy; higher education; awareness; challenge; Malaysia

INTRODUCTION

Rapid economic and social changes occur worldwide, including in Malaysia, causing environmental problems, such as greenhouse gas (GHG) emission, rising climate change, natural resource exploitation, decreased energy and water sources, and other problems that affect human life (Thompson 2017). In this regard, sustainable growth is introduced to improve the economic and social sector without neglecting the importance of natural environment (Gialos et al. 2018). Much effort has been taken by the government to ensure sustainable development. In particular, the government has drafted environmental policy changes that consist of four distinct stages involving deforestation, water and air pollution; wildlife and habitat loss; global warming; and national and international environmental management (Nowotny et al. 2018).

Another sustainable act focuses on clean energy consumption by using alternative energy sources; energy efficiency technology dissemination also plays crucial roles in sustainable development (Cadoret & Padovano 2016; Fowler & Breen 2014; Gielen et al. 2019). The modern society considers energy as a necessity for different purposes, such as electric power, transportation and heating or cooling (Delucchi & Jacobson 2011; Gielen et al. 2019; Jacobson & Delucchi 2011). Energy resources are divided into three categories, namely, fossil fuel (Abas et al. 2015), renewable energy (RE) (Ahmed et al. 2019; Selosse et al. 2018; Upton & Snyder 2015) and nuclear energy (Edwards

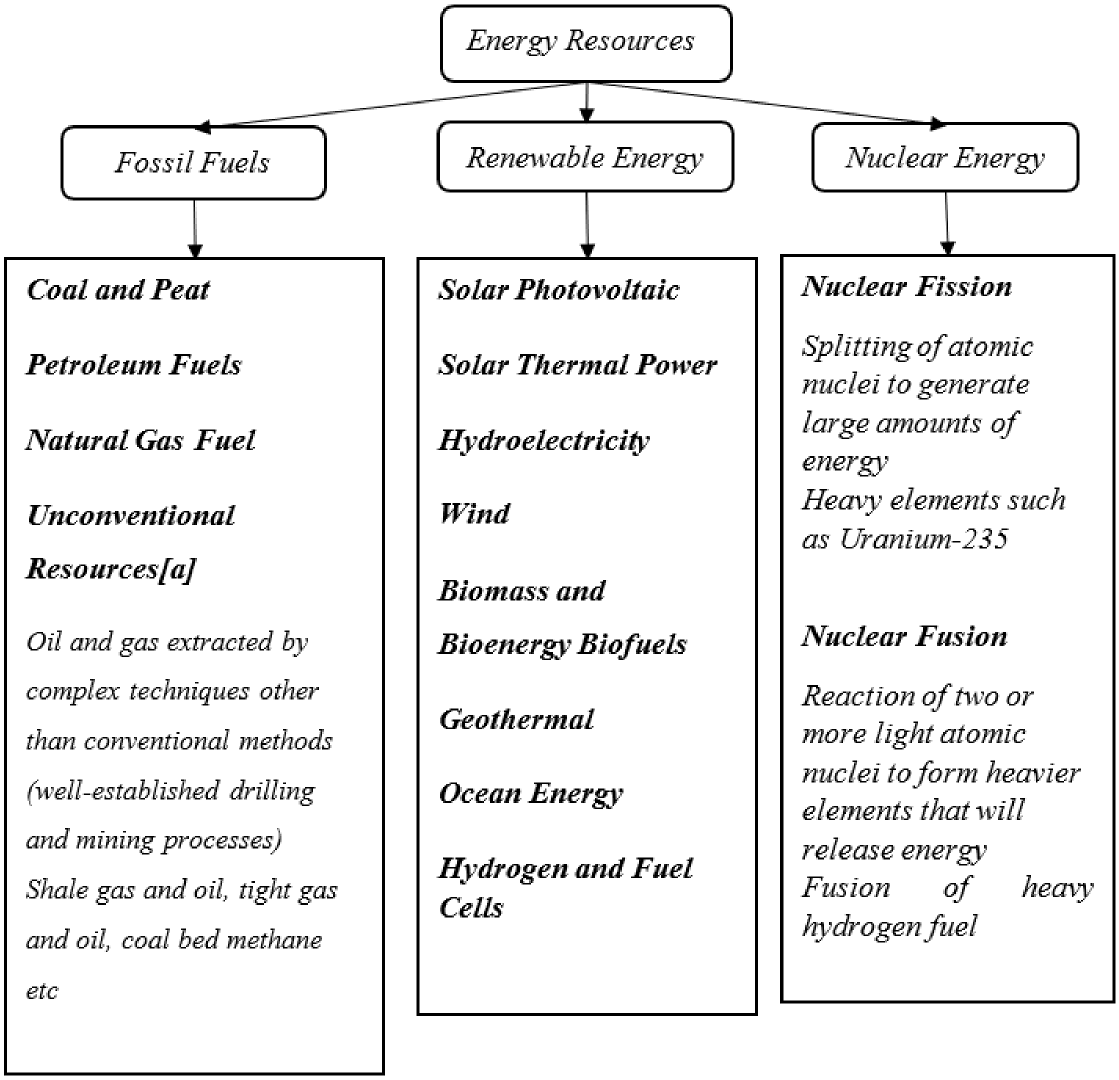

FIGURE 1. Energy Resource Classification

et al. 2019; Gralla et al. 2017; Suman 2018). Figure 1 shows the types of energy resources consumed at present:

Since the discovery of fossil fuel, it has been the dominant energy source worldwide. Considering the environmental problems and depletion of fuel sources, scholars aim to find alternative types of energy, such as renewable and nuclear energy. Shortly after the first oil crisis, many countries took initiatives in developing and deploying alternative energy technologies to avoid power crisis (Apergis & Apergis 2017; Can Şener et al. 2018; Gielen et al. 2019). Many developed and developing countries have changed their energy policies to find and develop new clean renewable energy sources such as in China, Spain, Australia and other Metropolitan areas (Capellán-Pérez et al. 2018; Dahal et al. 2018; Ralph & Hancock 2019; Stokes 2013; Yang et al. 2019).

Lin et al. (2016) reported that the deployment of alternative energy technologies does not meet the expectation of planners, organisations and researchers (Lin et al. 2016). Few alternative energy technologies, such as hydroelectric (Ozcan 2018), solar energy (Ding et al. 2019) and wind energy (Cao et al. 2016), have been successfully disseminated into big market, whereas others remain in small-scale adoption (Harjanne & Korhonen 2019; Nguyen & Kakinaka 2019; Sheikh et al. 2016). The BP Statistical Review of World Energy stated that in 2017, the world's primary energy sources were oil (34%), coal (28%) and natural gas (23%), followed by hydroelectric (7%), nuclear (4%) and renewable energy resources (wind, solar, geothermal and biomass) (4%).

In Malaysia, power generation is heavily dependent on fossil fuels despite that the country has many renewable resources that can be converted into energy. The review of Ho (2016) highlights the importance of renewable resources, but RE development is slow (Ho 2016). In general, based on RE implementation and current energy policies, fossil fuel will remain the dominant source for power generation in the future (Shaikh et al. 2017;

Shamsuddin 2012; Sohni et al. 2018; Sovacool & Bulan 2012) due to the supply and demand. It can be done if there is a strong support for fossil fuel power generation and continuous political interference (Hossain et al. 2018; Kardooni et al. 2018; Sovacool & Drupady 2011). Thus, Malaysia has antagonistically continued its goal to endorse and rise the share of RE in the country's energy mix (Salsabila Ahmad et al. 2011; Chien Bong et al. 2017; Kardooni et al. 2016), which began in 2011 under the 10th Malaysia Plan (10MP 2011–2015). In 2015, Malaysia achieved 985 MW for new energy target, contributing to 5.5% of Malaysia's total electricity generation mix. The National Renewable Energy Policy 2010 was launched to achieve its target by implementing several action plans and developing new initiatives. Kardooni et al. (2016 , 2018) reported that perceived usefulness (PU) influences the intention to apply renewable energy (Kardooni et al. 2016, 2018). Perceived ease of use (PEOU) is another important factor. Therefore, these findings are barriers to developing renewable energy in Malaysia.

The weak implementation of alternative energy technologies may be caused by several parameters, such as high initial capital cost and lack of awareness to technology (Luthra et al. 2015). (Lucas et al. 2018; Nowotny et al. 2018) discovered that the most disappointing factor is the lack of research and development work caused by inadequate curriculum of energy education, especially for alternative energy education (Foo 2013; Middleton 2018; Ocetkiewicz et al. 2017). This important element that is not well provided will lead to lack of trained technicians as well as high cost and deployment of inappropriate designs of alternative energy technologies (Jaber et al. 2017; Overberg et al. 2019).

Therefore, this article will review a proper alternative energy education that is very crucial for every developed and developing countries (Hannan et al. 2018; Sarkodie & Adams 2018; Schumacher et al. 2019), especially in Malaysia. Raising public awareness on alternative energy education and related issues is one of the top priorities in achieving sustainable development and improving the quality of life. Importantly, policy makers must understand the latest developments in renewable energy technologies and their strengths and capabilities in preparing sustainable energy supply selection to meet global energy demands.

STATUS OF ALTERNATIVE ENERGY IN MALAYSIA

Energy sector plays an important role in the Malaysian economy towards becoming an industrialised country since its independence in 1957. As of 2016, Malaysia's final energy consumption recorded a growth of 10.5% to settle at 57 218 kilo tonnes Oil Equivalent (ktoe) compared with the previous year at 51 806 ktoe (Tenaga 2016). Therefore, Malaysia's energy policy is revised accordingly to ensure sustainability development and energy resource security (Islam et al. 2009).

The first national policy focusing on electricity sector was introduced in 1979 and named the National Energy Policy, with three main objectives; supply, utilisation, and environment. In 2001, Five-Fuel Diversification Policy under the 8th Malaysia Plan (2001-2005) was announced, in which renewable energy was made the fifth commonly consumed fuel-based after oil, natural gas, coal and hydro. The target of the government is that renewable sources should contribute 5% of the national grid electricity in 2005. However, the contribution only reached 0.3% to the grid under Small Renewable Energy Program (SREP) conducted by the Special Committee on Renewable Energy (SCORE). This target is continued into the 9th Malaysia Plan (2006-2010), but reached only 8.3% from the target (Islam et al. 2009).

In the 9th Malaysian Plan, the significance on energy efficiency is intensified in line with sustainable development agenda. The National Green Technology Policy was launched in April 2009 to facilitate education, awareness and growth of Green Technology industry and eventually improve the economy (Bujang et al. 2016; Mekhilef et al. 2014). In the 10MP, the National Renewable Energy Policy and Action Plan focuses on awareness and growth of renewable energy industry (Hannan et al. 2018). Hannan et al. (2018) studied nuclear and RE programs and future energy planning. The critical review on conflict between this alternative energy is illustrated based on overall performance then put benchmarks and projection targets up to the year 2030. (Hashim & Ho 2011) found RE as a promising source in global energy mix. As such, RE is a key component to start focusing and drive towards energy diversification in Malaysia. Although Malaysia is still at an early stage, RE potentially could save the country over a period of five years of RM 5 billion (US$ 1.32 billion). Figure 2 shown the projection of RE in Malaysia until 2050 (Office n.d.). From the figure, Malaysia put more effort to increase the generating alternative energy especially for solar. Green Technology Master Plan Malaysia (2017-2030) and The Blueprint for Fuel Cell Industries in Malaysia (2017-2050) as these plans also discussed on the green technology's promotion and awareness for public.

Moreover, Oh et al. discovered that Malaysia should put more focus on investments and continuing to pursue RE sources available either in solar and biomass forms instead of nuclear energy (Oh et al. 2018). Poh et al. discovered the effect of policy development and continuity of new technologies on energy efficiency, such as in mass

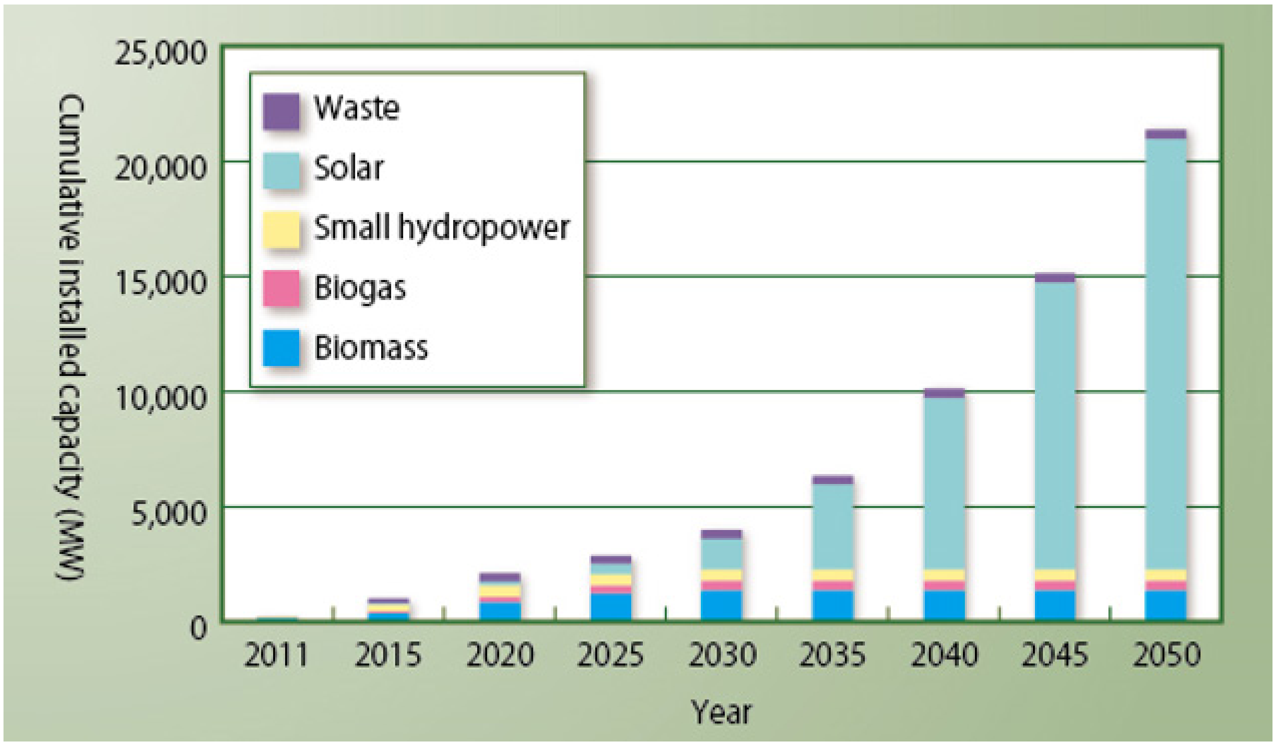

FIGURE 2. Malaysia's objectives for the introduction of renewable energies

public transportation system, improving automobile efficiencies, reducing energy consumption in buildings, encouraging good industrial ecology practices and designing compact living among societies (Poh & Kong 2002). It also can be done with RE generation by promoting recycling Malaysia's potential and minimizing wastages. RE policies developed by the Malaysian government to mitigate the issues of environmental impact, namely, energy efficiency and energy security, to meet the increasing energy demand (Chua & Oh 2010; Maulud & Saidi 2012).

Malaysia is blessed with variety of RE and alternative energy resources (Jennings & Lund 2001; Kandpal & Broman 2014), such as solar, hydroelectric, wind, landfill gas and municipal solid waste (MSW), and hydrogen fuel cells (Oh et al. 2018). However, the main energy sources are limited to oil, natural gas, coal, and hydro power. The rapid depletion of fossil fuel reserves and climate change have strongly encouraged Malaysia to drive the world towards alternative energy sources, such as solar power, municipal solid waste, biomass, biogas, fuel cells, and geothermal power (55, 65).

Chua et al. (2010) discussed the potential of palm oil waste as energy source. Oil palm plantations cover 15% of the country (4.7 million ha) and produce significant amount of 18 million tonnes of palm oil per year. The palm oil industry potentially produces combustible waste including biomass and biogas of palm oil mill effluent (POME), which could generate country's electricity up to 20% by 2020 (Salman Ahmad & Tahar 2014).

Although vast efforts have been implemented by the government, Kardoni et al. showed that only two of five people use RE products in Peninsular Malaysia (Kardooni et al. 2016, 2018). This phenomenon is because of the expensive price of RE products, ineffective programs and initiatives and lack of awareness on government policies (Kardooni et al. 2016). Thus, education that focuses on the environment and clean energy technologies should be introduced at all levels (Nowotny et al. 2018). Moreover, suitable programs or campaigns should be developed to increase public awareness. In 2020, free Hydrogen Bus Service in Kuching is provided to locals and tourists. Hydrogen bus can travel up to 300 km and travel 15 times in Kuching city with one hydrogen refill or hydrogen tank (Kandpal & Broman 2014).

MODES OF ALTERNATIVE ENERGY EDUCATION

Education is a very important means in providing solution for raising alternative energy awareness. Therefore, energy education is a must for the entire population to solve the increasing undersupply and prices of fossil fuels and address climate change concerns because these issues will affect the whole world if not treated seriously. Alternative energy education is increasingly emphasized across the whole world whether in formal or non-formal education.

According to Kandpal and Broman (2014), the objectives for alternative energy education as shown in figure 3, may include:

Alternative energy education is anticipated to play a very important role in promoting sustainable development and improvement towards life quality of the society. Thus, Philip Jennings (2001) suggested the reconstruction of energy studies as new discipline, which can be classified into two types of energy education (Newborough et al. 1991); i) focuses on preparing energy professionals via higher learning institution and ii) creating a more energy-literate society via compulsory primary and secondary

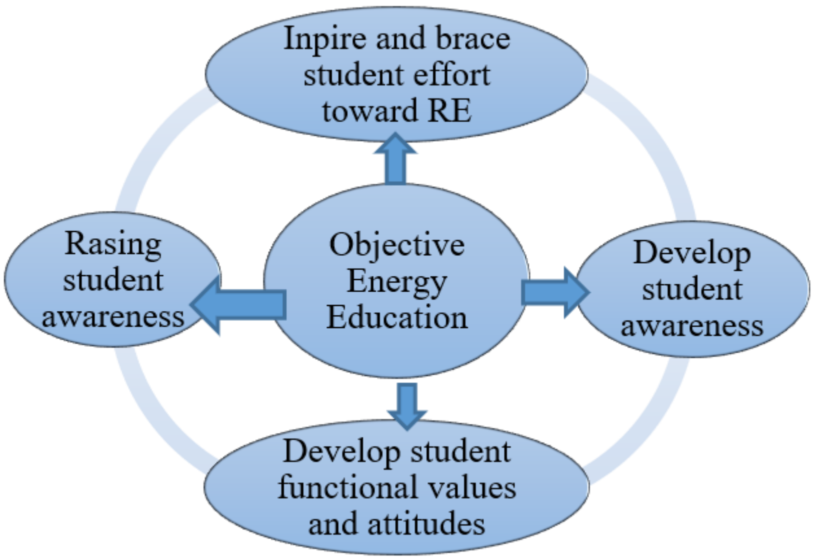

FIGURE 3. The objective of alternative energy education

education. Therefore, the framework of alternative energy education for every level of society is different, from students, higher institution learners, educators, mechanics and technicians, policy makers, project developers and common public (Kandpal & Broman 2014).

Given that alternative energy implementation involves global challenges, the promotion of learning it should be implemented to all levels of communities. Thus, formal, non-formal and informal types of learning must be used to promote this education (Eshach 2007). Formal learning includes purposeful and well-planned instructions based on identified objectives in academic institutions, such as schools and universities. Non-formal learning usually occurs outside schools in institutions, organisations, and scientific fieldtrips but still in a planned but highly adaptable manner. On the other hand, informal learning applies to spontaneous situations in life from family circle, neighbourhood, mass communication media, and from unorganised instructed organisations (Eshach 2007; Kandpal & Broman 2014).

In detail, energy education will have to be prepared in school level for generating energy awareness among the public especially for student and also for delivering first-hand experience to their applications with proper efforts and basic concepts. Mass media or short-term courses should achieve this goal. Diploma level or certificate courses will have to be further continuing preparation of personnel for research, fabrication, installation and maintaining RE systems. Furthermore, an Energy Engineering course shall be required for the fourth year of regular bachelor degree with specialisation in RE and energy conservation area to prepare students for research and development (R&D) and for designing and evaluation of emerging RE technologies. Finally, suitably framed postgraduate courses may be required for fresh graduates who are eager to further specialise in RE specific sides or for mid-career training of engineers and scientists interested in working on RE technologies. For the next section, alternative energy education will be explained in Malaysia's context and according to levels, namely, schools, colleges and universities.

CRITICISM OF ALTERNATIVE ENERGY EDUCATION IN SCHOOLS

Energy education is formally introduced in Malaysia school's curriculum starting in primary school. At grade five, the education focuses on use of energy, energy forms, energy sources, namely, non-renewable (oil, coal, natural gas and nuclear energy) and renewable (hydroelectric, solar energy, wind energy, wave energy, geothermal energy), energy transfer and transformation, energy saving and basic electric (Jalaludin SMYS & TM n.d.). As such, students will be exposed to basic knowledge and energy concepts from early school level.

In the lower secondary school, energy topic is introduced in form one science subject but the discussion is more in-depth compared with that in primary level (Periasamy NBAV 2016). In form three, students will learn about energy resources in Malaysia and other countries in the subject of geography. In Malaysia, energy resources, such as oil, coal, natural gas, hydroelectric, solar energy, biomass energy and nuclear energy, are included either in dissemination or research stage only. Example of energy resources in other countries are solar energy in Japan, wave energy in France, tidal energy in China, wind energy in the Netherlands, biomass energy in India and geothermal energy in Iceland (Nor ARM 2004). Thus, this topic will not only discuss Malaysia's energy resources but also energy resources from other countries and attain knowledge as to why certain type of energy resources are used in certain country but not in other countries.

The topic of energy education is further deliberated at upper-secondary for students who enrolled in science stream classes in Physics subject with more Math and scientific explanation in form four (Hamzah, Leong, Chuan & Kok 2016). The generation and transmission of electricity system from non-renewable and renewable resources (engineering perspective) is learned in form five (Hamzah, Leong, Chuan & Leh 2016). From the curriculum included in the school's textbook, learning of renewable energy, including hydroelectric, solar, wind, wave, tidal, biomass, geothermal and nuclear energy, is an important element in sustainable energy education. However, knowledge on hydrogen energy and fuel cells remains limited in this level. This issue should be questioned as research on hydrogen energy and fuel cells has long been conducted by researchers in Malaysia and in other countries worldwide. For school level, in form four chemistry subject, students will learn about electrolysis, in which electricity is converted into chemical energy (Neo et al. 2016). This process is the most basic hydrogen production from water, yet hydrogen as energy source has not been included in the Malaysia's school curriculum.

In 2008, Hashimah et al. (2008) found that students have not developed a strong knowledge foundation about renewable energy upon completing their secondary school (HM et al. 2008). Developing the fundamental students' awareness of RE is not as simple as offering sophisticated knowledge to adults. For example, inappropriate learning module and methods could cause the features of knowledge would not be accomplished. The attitude of the teacher who chooses the method through the authorisation of the contents of the textbook regardless of the tendency and interest of the diverse students, coupled with sometimes, shortage of textbooks has led to increased issues on energy education (Haron et al. 2005). Students are unable to apply the concepts and processes of science learned in schools with their daily practice outside school when teachers rely solely on the content of the textbook (Nordine et al. 2011).

A very strong learning strategy should be applied to enhance students' interest in Science, Technology, Engineering and Mathematics (STEM) education. The strategy is also applied to energy education where the instruction should approach integrated understanding to enhancement students' capability to make sense of environment and daily life phenomena on energy-related learning in the future (Nordine et al. 2011). The point forward will discuss strategies applied in schools in Malaysia.

PEDAGOGY

As the age progresses, teaching and learning process also change according to current needs. Traditional way of teaching, teacher-centred, content-oriented and exam-focus commonly used by teachers and lecturers for centuries is less appropriate and does not have a profound effect on students.

In the 21st century, effective teaching and learning for students has been a major educational goal. With the phenomenal advances in information and communication technologies, the interconnectedness of people and places is greatly increased, as reported by (Nijhuis et al. 2015). People, including students regardless of age and places, all over the world from east to west and north to south can find the latest news, information and knowledge within seconds as long as internet access is achieved. As such, traditional methods based on lecture-based and teacher-centred approaches should be directed to student-centred as students nowadays are more advanced compared to the last century. Salam et al. (2019) established three main components of the proposed framework for determining effective technology integration in service learning (Salam et al. 2019). Respondents from the case study reflected on technology utilisation throughout their facility learning projects and their own service-learning implementation process, highlighting constrains from current technologies for effective integration learning in pedagogy. Perera et al. (2019) demonstrated school-specific and socio-economic factors (Perera & Asadullah 2019). After accounting for the contribution of these factors, more than half of the accomplishment gap between the two high performers and Malaysia remains unexplained. Educators and teachers should have the skilled pedagogies and critical thinking skills to create exciting and active learning for student's engagement in a classroom.

Aadu et al. (2018) discussed the development of pedagogical means and curricula for teaching and learning within the domain of RE education (Ott et al. 2018). The researchers discover pedagogical approach based on solar energy education. Perkins et all. (2018) discovered the pedagogy style in climate change education internationally (Perkins et al. 2018). The five main visions of scholars in education for sustainability are as follows: i) teaching all forms of scientific knowledge as embedded in some level of nuance, complexity and uncertainty; ii) comprehensive empirical knowledge of climate change that includes its main debates, myths and principles; iii) critical engagement, integration and inquiry with cross-disciplinary and global perspectives; iv) learner-centred and transformative pedagogies conducive to sustainability and climate change curricula; and v) climate change mitigation and student-learner authentic participation in the study (Juhary 2015; Perkins et al. 2018).

INTEGRATED STEM EDUCATION

STEM is a lifelong education that encompasses learning and integrates science, technology, engineering and mathematics formally based on the curriculum. STEM education can be implemented in non-formal manner through co-academic and co-curricular activities. The STEM approach integrates knowledge, skills and values in subjects in-depth through inquiry approaches, project-based learning and problem-based learning in real-world contexts. Students conducting STEM activities are critical thinkers, innovative, prudent, self-reliant and technology savvy and can create, solve problems and make decisions

Previous studies showed that the integrated STEM learning promotes the 21st century workforce skills (Apedoe et al. 2008; H et al. 2011), enhanced student's learning experience and achievement (Venville et al. 2004; Wang et al. n.d.). Efforts are also being made to strengthen STEM teaching and learning to attract more students to STEM at school level with activities that incite the mind through inquiry, problem-based learning and project-based learning..

In emphasising STEM learning for young children, it must comprehend more simple skills or more than facts, rather than classroom infused with appropriate and interesting opportunities especially in engaging Math or Science subject. Instructions must emphasise with research-based learning trajectories, including three components, namely, instructional activities, developmental progression and goal. Of course, RE needs science technology to further develop. Much research can be done to improve the needs of RE development now especially the advanced materials and green technology division. All of this requires the contribution of scientists to explore and study. Therefore, STEM subjects are very much needed to produce a generation that is literate in the field of RE as well as developing the technology.

INTEGRATING INFORMATION AND COMMUNICATION TECHNOLOGIES (ICT) IN EDUCATION

The involvement of ICT in learning sessions is important to provide students opportunities in operating an information age. To overcome these barriers, educators should study the obstacles of ICT in education, besides it becoming successful technology adopters in the future (Johnson et al. 2019; Klimov 2012). Despite changes in the views of the role of science education and nature of science (Alt 2018; Yieng & Saat 2013), the increasing commonness of ICT also pursue a challenge to science education and offer scientific practice models to educators and students (Umar & Hassan 2015).

ICT is the latest technology in facilitating all forms of communication and information delivery, including facilitating the operation of a technology. Of course, ICT is very much needed in developing and increasing the usability of RE technology for use in daily life. For example, completing Inter of Things (IoT) for off-grid power sources such as hydrogen fuel cells in the agricultural industry where farmers can monitor the condition of their vast farms via mobile phone without having to go to the farm itself. This will definitely make it easier for the next generation to improve the economic sector. Thus, this specific subject can be taught in school and university level then integrated in green technology and RE.

ALTERNATIVE ENERGY EDUCATION IN COLLEGES AND UNIVERSITIES

Developing understanding and awareness among students are the aims of RE education courses or programs in university level. The program focuses on awareness on energy classification, nature and causes of energy crises, RE source technologies and conventional conversion processes of RE. The program also provides enrolled students the opportunity to suggest alternative processes, technologies, strategies etc., for protecting the environment, solving energy problems and improving the final efficiency in future education.

Knowledge of energy itself has not been regarded as a separate discipline of education since students in other disciplines (e.g., mechanical, chemical, electrical engineering, as well as physics) are exposed to relevant aspects (of energy extraction, conversion, transmission and distribution, utilization, etc.) as a part of their curriculum. In these disciplines, the subject of energy is not pictured with all of its own aspects. Thus, independent courses dealing with energy-related issues are not offered to undergraduate students. However, on postgraduate level, many colleges and universities started to introduce alternative energy programs. For example, in Universiti Kebangsaan Malaysia (UKM), few faculties and institutes have offered desirable features and high levels of energy education programs:

1. Faculty of Science and Technology offered Master of Science (MSc) in Solar Energy by research;
2. Solar Research Institute (SERI) offered MSc or Doctor of Philosophy (PhD) in Renewable Energy Resource Assessment / Energy Management, Economic and Policy / Wind and Marine Energy Technology / Solar Photovoltaic System and Advanced Solar Cells / Advanced Solar Thermal Technology by research;
3. Institute of Cell Fuel offered MSc/PhD in Fuel Cell Engineering / Hydrogen Energy by research.

The available records show the curriculum course contents for postgraduate-level teaching programs in university or other campus. The inputs provided to students can be generally divided into three components: i) basic concepts; ii) performance analysis and evaluation and detailed models for component/device and; and iii) related issues in manufacturing and fabrication including system design, materials considerations, standardisation, testing, operation and maintenance installation, environmental aspects and techno-economic evaluation.

At present, the majority of education programs are imposed in classroom. However, particularly for offering courses for mechanics and technicians, a large number of initiatives recently in the direction of offering online programs. Many programs offer both options for students. Online programs offer the freedom to learn at one’s own pace (except for classes offered via live video or teleconferencing) and also the flexibility to study from home. It often makes use of reading or materials by pre-recorded lectures. Students undertaking online programs also have to be present for internship arrangements or specific classes to ensure lack of compromise with the hands-on training component of the study.

Moreover, Malaysia should embark on cultivating quality education by its’ introduction of the Malaysia Massive Open Online Courses (MOOC) initiative. Through the initiative, Malaysia has currently 59 MOOCs with over 200 000 students developed by Ministry of Higher Education Malaysia in collaboration with 20 public universities, including UKM, where it currently has 49 MOOCs, with an enrolment of over 72 000 students. The keynote paper discusses the development of the UKM MOOC initiative and its’ transformation on the teaching and learning practices in the university as well as its’ impact on the local and international educational landscapes.

CONCLUSION

Malaysia is committed to implement renewable energy and green technology, which is the cornerstone of economic development for all countries. Green technology is an environment-friendly low-carbon technology for reducing emissions of carbon gases into the air, which causes other weather phenomenon worldwide. The implementation of new curriculum on alternative energy education is also expected to foster awareness among students about the importance of preserving and conserving the environment.

Hence, students should be given knowledge and experience to preserve and conserve the environment, especially on the use of green technology to avoid activities that cause environmental degradation. Other level of societies, such as educators, mechanics/technicians, policy makers and common public also play important roles in the dissemination of alternative energy technologies to replace conventional technologies, such as oil, coal and natural gas, which release harmful greenhouse gases.

It is safe to deduct that educating the population about energy and climate change related issues and exposing them to the state-of-the-art alternative energy technologies is of immense importance. Awareness generation among current users is necessary for enhancing the adoption of new emerging technologies. The education should be implemented in every way possible that can increase green awareness either in formal, informal or non-formal manner.

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DECLARATION OF COMPETING INTEREST

None.

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