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Noor Fitriyanto<sup>1, a)</sup>, Mochamad Bruri Triyono<sup>1, b)</sup>, and Saijo<sup>2, c)</sup> <sup>1</sup>Technology Vocational Education, Graduate School, Universitas Negeri Yogyakarta, Caturtunggal, Depok, Sleman Regency, **Special Region of Yogyakarta** 5528, Indonesia

<sup>2</sup>Agrotechnology, Faculty of Agriculture and Forestry, Universitas Muhammadiyah Palangka Raya, Langkai, Pahandut, Palangka Raya City, Kalimantan Tengah 73111, Indonesia a) Corresponding author: mnfitriyanto@umpr.ac.id b)bruritriyono@uny.ac.id c)saijo0674@gmail.com Abstract.

**This study discusses the additional concept of Green Skills, with the aim of forming more competent workers in an industry that currently demands green jobs.**

So, **it is necessary to** have stages of competency formation in developing students' cognitive abilities to become green employees who are environmentally friendly and care about the environment. Until now, only a few studies have guided and revealed **the needs of the** community in meeting the demands of green skills, especially in Vocational High Schools. This paper uses a literature review-based methodology to identify Green Skills and formulate cycle stages that shape student competencies.

It was found that from the results of a literature **study on green skills** competencies to realize in school, **it is necessary to** have a special application model in vocational schools into learning, so that a concept known as 6R is found competence to reuse, recycle, reduce, repair, reassemble, and resaving energy. To make realistic creative TVET innovations according to **the needs of the** Industrial Revolution 4.0 based on green skills materials through virtual technology based on virtual reality. To diffuse creative TVET

innovations into the community TVET Institutions, Government through the policy of infusion of green skills learning into the curriculum, Society, and Stake Holders can be done by joining Green Leaders Indonesia (GLI), GLI is a movement of young Indonesians to bring together and encourage collaboration between activists of the environmental care movement, green technology developers, stakeholders, government, and leaders of the ministry of the environment to create environmentally friendly solutions. Therefore well **the aim of the** movement having a better impact on the current environmental damage phenomenon. It is no stranger th at **environmental problems have become** a classic problem in Indonesia, especially in TVET.

The six main requirements above will be fulfilled if they are supported by the Vocational Education objectives in training green skills to form green employees. The novelty of this research is that there are six main requirements in the application of green skills with conditions that are supported by the goal of Vocational Education to form green employees. INTRODUCTION Green Skills are skills that are needed **in every human group that** has a ll fields **of work in an organization** that exists in this century [1].

This **is in line with** Buntat and Othman's [2] statement that Green Skills, also known as "Green Soft Skills", are complementary to Green Jobs and Green Careers. The **development of vocational education** is very much determined by future developments and challenges, one of which is environmental sustainability. Environmental issues have recently raised various programs, policies and theories related to environmental conservation.

Various parties, including government, private sector, and academia, have created programs that are often started with the word "green" which means environmentally friendly. Along with this development, the world of industry and business today has begun to lead to activities that refer to ecology and are oriented towards environmentally friendly work activities. Downloaded from [http://pubs.aip.org/aip/acp/article-pdf/doi/10.1063/5.0106326/17429652/040010\\_1\\_5.0106326.pdf](http://pubs.aip.org/aip/acp/article-pdf/doi/10.1063/5.0106326/17429652/040010_1_5.0106326.pdf) The urgency of the environmental crisis is increasingly massive in Indonesia, with various disasters coming almost every month. This is a phenomenon that makes us think.

If studied, one of the factors that causes several disasters to occur is a decrease in the quality of the environment. This phenomenon makes us think back and relate the incident to the educational process that was applied. Land and forest fires that occur during the dry season, floods and landslides that occur in the rainy season create problems for the life of this nation. The problem of air pollution in big cities is due to the high use of motorized vehicles, the attitude of the population who still littering, and

there are still many deviations in behaviour that can reduce the quality of the environment itself.

Indonesia is also one of the countries that relies on the extractive sector to drive its economy, such as coal, mining and minerals, even though **Indonesia is one of the** countries with the largest renewable energy potential in the world such as geothermal, solar, wind and hydro. According to employment trends, there are many areas of expertise in Vocational Education (VE) that provide automation and trend development for development, Directorate of Vocational Development limit the areas to be revitalized. It is also **in order to carry out** the institutional arrangement of expertise competencies that exist in the SMK is somewhat able to answer the challenges and dynamics of the development of science and technology.

These areas are: Revitalization sector above, is the focus of the area of expertise that will be intervened for 5 (five) next year. This is a priority area national and support national development. Every area of expertise the intervention in total from interventions that are physical and physical non-physical access and quality up to the competence of expertise. So, it is hoped that with one intervention the school can continue develop, grow progressively and independently. Component the revitalization program represents this.

The form of the paradigm theoretical basis which is used as the basis for the target of the activity at the same time answer the strategic and program objectives that have been determined by the Ministry of Education and Culture. The following are program details revitalization 2020-2024. TABLE 1. Vocational high school development program plan for 2020-2024 [3] No Program Activities 1 Renovation of buildings and supporting facilities School environment arrangement 2 Revitalization of practice equipment Procurement of equipment according to industry 4.0 3 Industry-based learning system update 4.0

Implementation teaching factory 4 Student competency certification Student competency certification 5 Collaboration with business and industry Demand driven school through industrial class 6 Strengthening work character Strengthening student character education International Labor Organization states that green jobs are jobs that can be categorized as environmental conservation work, including: reforestation work, waste processing, waste recycling, organic farming, mangrove planting, and various other environmentally oriented jobs .

Vocational education as a competency-based education system strives for the learning outcomes of vocational education to have competencies, skills and expertise that are

relevant to market needs, including mastery of ecology and green jobs. This means that the adaptation of environmental education into vocational education will create a new philosophy as a consideration in the implementation of vocational education in the future. The Policy Direction and Strategy of Vocational Education in the latest Strategic Plan also states that the current human resource development takes into account the balance trends related to rapid technological advances, environmental changes, and differences in the future world of work in the field of education at every level and in the cultural field.

If this development is not immediately anticipated by vocational education, of course, there will be a gap in the qualifications of the graduates' skills with the demands of the workforce in the industrial. Current and future labor market needs lead to job competencies that require being able to carry out work in an environmentally friendly manner, which means that competency building must add an environmentally friendly philosophy to the provision of vocational education. The adaptation of environmental education into vocational education will create a new philosophy as a consideration in the implementation of vocational education in the future.

This means that green skills and environmental awareness are priorities and challenges for vocational education today and in the future. Competency standards are a measure for the achievement of learning outcomes in the learning process in vocational education. Downloaded from [http://pubs.aip.org/aip/acp/article-pdf/doi/10.1063/5.0106326/17429652/040010\\_1\\_5.0106326.pdf](http://pubs.aip.org/aip/acp/article-pdf/doi/10.1063/5.0106326/17429652/040010_1_5.0106326.pdf) In order to form competent vocational students in the fields of soft skills, hard skills, and green skills. Therefore, further studies are needed in mapping the 21st century green skills competencies.

The problem statement in this research is how to make realistic creative TVET innovations according to the needs of the Industrial Revolution 4.0 based on green skills and how to diffuse creative TVET innovations into the community. TVET Institutions, Government, Society, and Stake Holders. Education for Sustainable Development (ESD) is a concept multidisciplinary perspective that looks at the concept of development from a social perspective, economy, and environment [4], [5]. This concept is not a new concept, but has been clearly presented in Law Number 20 of 2003 concerning the National Education System as well as in the Preamble to the Constitution of the Republic of Indonesia 1945.

Strategic Plan of the Ministry of National Education 2010-2014 includes this concept in the national education paradigm, namely: education for development, development, and/or development sustainability. This paradigm states that education produce

humans with noble character, humans who are a blessing for universe, namely humans who fulfill their needs by taking into account **the needs of the** current and future generations future (intergenerational sustainability). The importance of implanted environmental education through education in schools will bring students into the next generation who love the environment. Landriany [6] explains that The importance of education will affect several aspects, among others.

Cognitive aspects, environmental education has a function to increase understanding of environmental issues, as well able to improve memory, application, analysis, and evaluation. The affective aspect, environmental education serves to improve acceptance, assessment, organization and personality characteristics in organizing life in harmony with nature. Psychomotor aspects, environmental education plays a role in imitating, manipulating in interacting with the environment in surroundings in an effort to increase the culture of loving the environment.

Aspects of interest, environmental education serves to increase interest in the child. Feinstein [7] explained that the application of ESD in America Unions are supported by components inherent in education environment-based (environmental education) which include awareness and sensitivity to environmental and environmental challenges, knowledge and understanding of environmental challenges and Environment, attitude to care for the environment and motivation to improve or maintain environmental quality, skills for identify and help resolve environmental challenges, and participation in activities that lead to the completion of challenges environment. Vocational Education has a very important role in realizing **Sustainable Development Goals (SDGs)** in 2030.

With graduates who competent, is expected to be able to compete both locally and internationally international because the purpose of vocational education, especially vocational education is to produce graduates who are ready to work and are able to compete globally professional. With the emergence of a professional workforce, it is hoped that improve social welfare, eradicate poverty, create quality education, create jobs that feasible and increasing economic growth, reducing inequality where this helps to realize the goals of Sustainable Development Goals (SDGs). The research question here is how to develop green skills through the application of the 6R concept and can be applied in vocational high schools.

The novelty that the research is development which initially only became 3R, each aspect was developed one by one so that it became 6R . The initial concept of reuse, reduce, recycle. Reuse is developed into repair, recycle is developed into reassembly, and reduce is developed into energy saving. This concept is an application of green skills in manufacturing. METHODOLOGY In the methodology, **the first step is** sechnology

for “understanding” green skills, providing insight into work readiness with environmental management materials through virtual technology.

The second step is green skills knowledge, providing training on job readiness with an environmental perspective using blended learning techniques. The third step is doing Green Behavior, apply 6R Concept Reuse, Recycle, Reduce, Repair, Reassembly, and Resaving Energy. The fourth step with Repetition Green Skills Practice regularly. In character building, steps two to four are always applied and repeated while students are in school and carrying out activities in the workshop or laboratory. Downloaded from [http://pubs.aip.org/aip/acp/article-pdf/doi/10.1063/5.0106326/17429652/040010\\_1\\_5.0106326.pdf](http://pubs.aip.org/aip/acp/article-pdf/doi/10.1063/5.0106326/17429652/040010_1_5.0106326.pdf) FIGURE 1. Road map for implementing work culture RESULT AND DISCUSSION Technology to understand green skills provide insight into job readiness with environmental management materials through virtual technology.

Virtual Technology is Virtual Reality with the aim of providing a general and detailed description. In other words, virtual technology provides knowledge, explanation and follow-up of understanding green skills. The existence of virtual technology in learning can help schools with limited tools/machines and doing preliminary simulation before committing to a real project. The existence of virtual technology in learning can help schools that have limited tools to be able to carry out preliminary simulations before carrying out real projects.

Learning like this is highly expected by the millennial generation because it is interactive, interesting, and varied choices. Jobs in The 21st century is more international, multicultural, and interconnected. The development of technology and information and communication has changed the way we learn, the nature of the work that can be done, and the meaning of relationships so social. Thus, through virtual technology, green skills are expected to give birth to innovation and changes in human civilization [8]. Green Skills Knowledge: providing training on work readiness with an environmental perspective using blended learning techniques.

Blended learning is believed to be able to bring learning trends and best practices must also be adjusted through blended learning or learning integrated. Therefore, in order for SMKs to achieve 21st century skills. Integrated learning is learning that integrates use of technology in learning that enables learning appropriate for each student in the class. Blended learning is learning that combines the best components of learning online and the best components of face-to-face learning [9].

The same opinion was also expressed by Bonk and Graham stating that blended learning basically combines the positive aspects of two types of learning environments,

namely classroom learning and e-learning [10]. The statement above can be understood that with blended learning weaknesses in face-to-face learning can be overcome by advantages of online learning. Vice versa, weaknesses online learning can be overcome with the advantages of face-to-face learning. Other than that, in relation to providing experience and skills using information technology, Blended learning allows students to do habituation in using information technology.

After receiving regular training and materials, then next implementing environmentally friendly competencies in schools by habituation of the 6 R namely reuse, recycle, reduce, repair, reassembly, and resaving energy. Doing Green Behavior: 1.Reuse 2. Recycle 3. Reduce 4. Repair 5. Reassembly 6. Resaving Energy Technology For "Understanding" Green Skills: provide insight into work readiness in Green Skills Knowledge: provide training on work readiness with a Repetition Green Skills Practice Downloaded from [http://pubs.aip.org/aip/acp/article-pdf/doi/10.1063/5.0106326/17429652/040010\\_1\\_5.0106326.pdf](http://pubs.aip.org/aip/acp/article-pdf/doi/10.1063/5.0106326/17429652/040010_1_5.0106326.pdf) FIGURE 2.

Model of cognitive **6R work culture concept** States that sustainable development is a perspective on activities that are carried out in a systematic and planned manner within the framework of improving the welfare, quality of life and the environment for mankind without reducing access and opportunities for future generations to enjoy and use them [11]. Recycle, where the manufacturing production process is designed in such a way that it can be recycled or reused. This is in accordance with recycle, namely recycling goods, for example, processing waste paper into paper or cardboard again, processing organic waste into compost, using products that are more environmentally friendly.

This is in accordance with the opinion [12]. Reduce is an activity to make used goods or waste into new materials in order to prevent the reduction of new uses so as to reduce pollutants, reduce greenhouse gas emissions. The development of Recycle is in accordance with the opinion [13]. Reduce can be produced so that it is not just thrown away but can be a new product that is more useful. Products produced from reduce can be in different forms thereby reducing waste production and creating a balance between production and consumption of resources.

Reduce is **the use of objects** that are not just thrown away but can become new products that are more useful. The products produced from reduce can be in different forms so as to reduce the production of waste and create a balance between production and consumption of resources. **Repairs can be done** by replacing parts that have been damaged so that damaged facilities and infrastructure can be used properly.

Reusable items that are not used can be used and put back together in a suitable combination so that become useful goods that can be used to support learning at school. Resaving energy is implementing the attitude of not turning on the electricity wastefully, using air circulation in the workshop without turning on the air conditioner in a day, and the movement to save water when washing hands. so that access to energy becomes efficient, can reduce production costs, and have an impact sustainable and modern for all.

To diffuse creative TVET innovations into the community TVET Institutions, Government, Society, and Stake Holders can be done by joining Green Leaders Indonesia (GLI), GLI is a movement of young Indonesians to bring together and encourage collaboration between activists of the environmental care movement, green technology developers, stakeholders, government, and leaders of the ministry of the environment to create environmentally friendly solutions. well with the aim of the movement having a better impact on the current environmental damage phenomenon. This program takes the spirit of the Youth Pledge which aims to unite youth to move towards a better Indonesia.

It is no stranger that environmental problems have become a classic problem in Indonesia, especially in big cities. Garbage, clean water crisis, waste of energy and pollution occur everywhere. From these problems, in 2015 a number of Bandung Institute of Technology students initiated Greeneration Indonesia (GI). Greeneration Indonesia is a social entrepreneurship that offers an environmentally friendly lifestyle through its products and programs. Green Skills Practice in Vocational High Schools as places of learning, not only need to support the ongoing process of good learning and teaching, but are also expected to have training for their students to build a clean and healthy environment and be able to form students who have better health degrees.

The concept of green school is part of the environmental education process for students, so that Vocational High Schools must provide training and practice to students directly to understand environmental conservation so as to form a caring character for the Reuse Competence Reduce Competence Recycle Competence Repair Competence Reassembly Competence Resaving Energy Competence Downloaded from [http://pubs.aip.org/aip/acp/article-pdf/doi/10.1063/5.0106326/17429652/040010\\_1\\_5.0106326.pdf](http://pubs.aip.org/aip/acp/article-pdf/doi/10.1063/5.0106326/17429652/040010_1_5.0106326.pdf) environment. Vocational High School as one of the graduate-based educational institutions who are skilled and ready to work makes the right place for the formation of skills in nature and environmental sustainability.

Vocational Schools are considered capable of forming a mindset (mindset) about nature and environmental conservation, as well as galvanizing students who will later



become agents of change (agent of change) in nature and environmental conservation. Pavlova [ 14] mentions several elements of Green Skills including environmental awareness, coordination, entrepreneurship, innovation skills, STEAM (science, technology, engineering, art, mathematic), and analytical thinking skills. Based on the results of the analysis that has been studied, there are 6 main components to form the skills of Vocational High School students so that they are ready to enter the world of work that is environmentally friendly.

These competencies are reuse competence, competence, recycle, reduce competence, repair competence, reassembling competence, and resaving energy competence. The six main requirements above will be fulfilled if they are supported by the school's objectives in training green skills to form green employee. Vocational High Schools play a very important role in participating in education and learning efforts in the aspect of green skills training.

Therefore, there needs to be an effort to form skills that do not only focus on hard skills and soft skills, but also train green skills so that the goal of forming quality resources can be fulfilled. The provision of knowledge and the formation of awareness about clean and healthy living behavior is considered very effective when carried out on students through the 5R concept. With vocational education, it is expected to be able to become an agent of change to implement and promote a clean and healthy life like when at school, this is in accordance with the opinion [15].

**CONCLUSION** In order to form competent vocational students in the fields of soft skills, hard skills, and green skills. Therefore, further studies are needed in mapping the 21st century green skills competencies. To realize green skills from the start in school, it is necessary to have a special application model in vocational schools into learning, so that a concept known as 6R is found competence to reuse, recycle, reduce, repair, reassemble, and resaving energy. To make realistic creative TVET innovations according to the needs of the Industrial Revolution 4.0 based on green skills materials through virtual technology. Virtual Technology is Virtual Reality with the aim of providing a general and detailed description.

In other words, virtual technology provides knowledge, explanation and follow-up of understanding green skills. The existence of virtual technology in learning can help schools with limited tools/machines and doing preliminary simulation before committing to a real project. Learning like this is highly expected by the millennial generation because it is interactive, interesting, and varied choices.

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way we learn, the nature of the work that can be done, and the meaning of relationships social. Thus, through virtual technology, green skills are expected to give birth to innovation and changes in human civilization. Green Skills Knowledge: providing training on work readiness with an environmental perspective using blended learning techniques. Blended learning is believed to be able to bring learning trends and best practices must also be adjusted through blended learning or learning integrated. Therefore, in order for SMKs to achieve 21st century skills.

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