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RESEARCH ARTICLE

THE ROLE OF TRANSFORMATION IN BIOLOGY SCIENCE AND EDUCATION FOR SUPPORTING SUSTAINABLE DEVELOPMENT GOALS

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ABSTRACT

Today in times of increasing inequality, climate change, and major social challenges, education is the best way to equip citizens, scholars and leaders to implement meaningful change and prevent future crises. Biology education and science will solve these problems to supporting sustainable development goals especially in soil remediation, clean water, education quality and clean and affordable energy. This paper will describe how biological education could solve these problems. New biology can solve the problem about hunger use biotech, use synthetic biological material to find new advance material. New biology could driving intersectorial, interdisciplinary and international connectivity, and the leveraging of existing investments in synthetic biology, materials science, allied science and technology areas, are the major challenges in delivering the Materials from Biology vision..

Keywords: Biology education, sustaiable development goals, new biology, biology science.

1. INTRODUCTION

Today in times of increasing inequality, climate change, and major social challenges, education is the best way to equip citizens, scholars and leaders to implement meaningful change and prevent future crises. Every crisis in the world must have a problem solving (Coombs & Laufer, 2018). Problems occur in every sector of life such as clean water resources (Meena & Luhar, 2018), land problems (Haowei Yu et al., 2019), air pollution (Yang & Zhang, 2018), poverty in developing and underdeveloped countries (Partners & Vick , 2013), clean energy (Hongtao & Wenjia, 2018), economic growth (Liang & Yang, 2019), industrial innovation (Liu, Gao, Chen, Yu, & Zhang, 2018), infrastructure (Morshedlou, González, & Barker, 2018), hunger (Luis & García, 2018), health problems (Lavie et al., 2018), quality of education (Wen, Xiao, Hui, & Zhang, 2018) and many other problems.

Every problem has been introduced in as the Sustainable Development Goals (MDGs) in 2014 initiated by the USA. Indonesia as a developing country supports the MDGs to solve the problem (Stalker, 2008). In the SDGs process in the last 40 years, countries with the lowest 25 percent ranking have increased the Human Development Index (HDI) to 82% (Nation Development Program, 2005). SDGs has focused on solving 17 international problems, especially in developing countries. Every problem in SDGs can be reduced by making quality standards and education levels in the right way. Education is a very important thing that continues to change (Faure et al., 2009). Every single problem in the world can be overcome with quality education. Several studies have informed many problems especially in developing countries (Muralidharan, 2017) can be solved by implementing quality education.

Biology science and education teaches others how to manage natural resources in an appropriate way. The new biology of the 21st century is necessarily interdisciplinary, system-oriented, and integrative (Fermon et al, 2010). Both the SDGs and the new Biology science and education assume great challenges as their focus. Instead of being limited to a particular topic or discipline, the focus aimed at tackling social problems and so-called "perverse problems", such as climate change and extreme poverty, which are difficult to solve as individuals; they demand collective action (Fermon et al., 2010). By virtue of its mission and ambition to address the challenges, the new Biology education and the SDGs will remain on the global scientific agenda for at least the next two decades. Some of the emerging-omic fields, such as metagenomics and pharmacomyrobiomy, directly report the relevance of the end points for the new Biology education, ecosystem health and the SDGs (El Rakaiby et al., 2014). The purpose of this paper is to analyze the possible part of the new Biology science and education in supporting the objectives of SDGs.

Fundamental interaction of Biology science and education with SDGs

Higher education is one of the most significant indicators of global competitiveness (Schwab, 2014) that gives an impact for economic growth (Peet et al, 2015). Therefore, higher education could support SDGs by producing high

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quality and high competitive human resources (see figure 1). Universities are part of higher education that also support SDGs (Beynaghi et al., 2016).

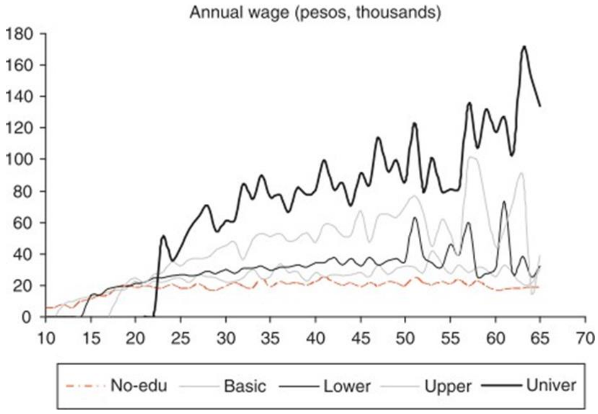

Fig. 1. Based on Age-Earnings Profiles by Education (Fiszbein et al, 2007)

Biology science and education in universities is a combination treatment utilized for supporting SDGs; nature resources such as soil remediation with biology process and treatment. Biology treatment has been successfully using biology community to nitrogen fertilization (Hailing Yu et al., 2019), biology process that successfully remediate to maintenance availability of clean water (Life, 2018), Biology science that supporting education for sustainable development (Azlina, Amran, & Radiah, 2013), biology science that could make clean energy from co-gasification of coal and biomass (Kamble et al, 2018). As we can see, biology science and education could support SDGs especially on soil remediation, clean water, education quality and clean energy (see figure 2).

Biology science and education in universities is a combined treatment used to support the SDGs; Natural resources such as the remediation of soils with biology processes and treatments. The biology treatment has been a successful use of the biology community for nitrogen fertilization (Hailing Yu et al., 2019). A biology process successfully remedied to maintain the availability of clean water (Life, 2018). Science of biology supports education for sustainable development (Azlina, Amran, & Radiah, 2013). Therefore, Biology science produce clean energy from the co-gasification of coal and biomass (Kamble et al, 2018) .As we can see, science and education in biology could support the SDGs, especially in the remediation of soils, drinking water, quality of education and clean energy (see figure 2). Science and biology education in universities is a combined treatment used to support the SDGs; Natural resources such as the remediation of soils with biology processes and treatments. The biology treatment has been a successful use of the biology community for nitrogen fertilization (Hailing Yu et al., 2019), a biology process that is successfully remedied to maintain the availability of clean water (Life, 2018), science of biology that supports education for sustainable development (Azlina, Amran, & Radiah, 2013), biology science that could produce clean energy from the co-gasification of coal and biomass (Kamble et al, 2018) . As we can see, science and education in biology could support the SDGs, especially in the remediation of soils, drinking water, quality of education and clean energy (see figure 2).

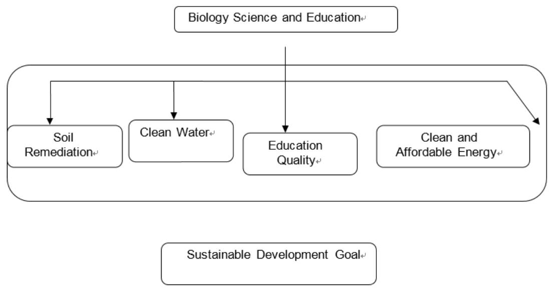

Fig. 2. Relation of Biology Science and Education with SDGs

Biology Science and Education Phenomena

Biology science has been developing every single year, for the example about systems biology of auxin in developing embryos, Biology systems are oriented to signal pathways in their biology context. The aim is always to need a model that ignores foreign factors and focuses on the most important path of the process given. The developing embryo contains many important processes in plant development; understand them interaction will be the key to designing plants that can maximize yield in more quantities challenging world. Here, this paper briefly summarizes the role of auxin during the embryo development. They highlight the latest advances in our understanding of auxin signal and discuss the implications for understanding the development system (Mironova et al, 2017). Trends on biotechnology has described about developing of biology systems on single-cell aging (Song et al, 2018).

Several study that informed about biology science and education in the world is science in the living world (Konopka, 2002). Biology is front page news, so it is important that we teach students to make connections between what they learn in the classroom and what they see in everyday life. As biology researchers, we recognize the negative implications of doing science in a vacuum as we are increasingly asked to communicate effectively with local and national legislators. As biology instructors, however, we may choose to teach biology devoid of social context, believing that students can make these connections on their own. But students model their instructors' behaviors, and follow their lead. If we integrate social issues into the biology curriculum, we model social responsibility for biology majors, and we demonstrate the need for biological literacy for nonmajors (Chamany et al, 2008). Based on biology curriculum, instructors may wonder how they will find space to bring in social issues especially on sustainable development goals.

Table 1. Mean earnings of the labor force by level of education – Latin America and Caribbean countries (index)

Country	No Education	Primary	Secondary	University
Argentina	35	62	100	171
Bolivia	74	77	100	219
Brazilia	60	81	100	201
Chile	55	59	100	311
Colombia	42	64	100	253
Costa Rica	50	63	100	202
Dominican Rep.	56	76	100	251
El Savador	42	63	100	208
Guatemala	30	55	100	247
Honduras	38	52	100	265
Jamaica	5	65	100	113
Mexico	19	54	100	173
Panama	50	54	100	224
Paraguay	51	63	100	212
Peru	73	82	100	253
Uruguay	40	77	100	154
Venezuela	47	75	100	172
Average	44	66	100	213

Source: (Psacharopoulos & Ng, 1994)

Since 1993, Introductory Biology has been a required course for all MIT undergraduates. Because over 900 students take Introductory Biology at MIT each year, we have the opportunity to offer three educationally equivalent versions of Introductory Biology. All three versions of the course cover biochemistry, genetics, molecular biology, gene regulation, Recombinant DNA technology, and immunology. The remaining time is spent on the areas chosen by the pair of professors teaching each version of the course. Thus, one version currently covers additional material concerning cancer, the nervous system, and genomics; another covers cancer and development; and the third covers ecology, additional biochemistry, and the genetics of microorganisms. Each course consists of 1-h lectures, delivered by professors three times per week, and 1-h small-group recitation sections, led by teaching assistants (TAs) twice per week. Each course also involves a full-time, postdoctoral-level instructor who plans recitation section, problem set, and exam materials. The effort in constructing our BIOLOGY CONCEPT FRAMEWORK was made possible by an HHMI Professor ship Award to G.C.W., which funded the creation of an Education Group, analogous to his research group. As part of the HHMI Education Group activities, postdoctoral associates D.G.H. and J.K. served as teaching assistants in one of the three versions of the Introductory Biology course at MIT. We were able to take the time to perceive the big picture of the class in terms of both the content and the organization and to think about realistic and incremental ways in which teaching and learning can be improved in the context of Introductory Biology at MIT (Chamany et al., 2008).

There are two major educational goals of the Introductory Biology courses at MIT. The first goal is to prepare biology majors to perform well in subsequent biology courses. The second goal is to create enduring understanding of key ideas by providing both majors and nonmajors with the tools with which to approach questions related to biology that they may face as members of society. This will additionally serve the majors by providing them with a framework for their future studies in biology. Understanding these ideas will serve students well, majors and nonmajors alike, when they are called on to make decisions personal or public (Peet et al., 2015) Biology science and education has been developing in every country with difference level, education levels will be give an impact on earnings on Latin America and Caribbean Country (Table 1).

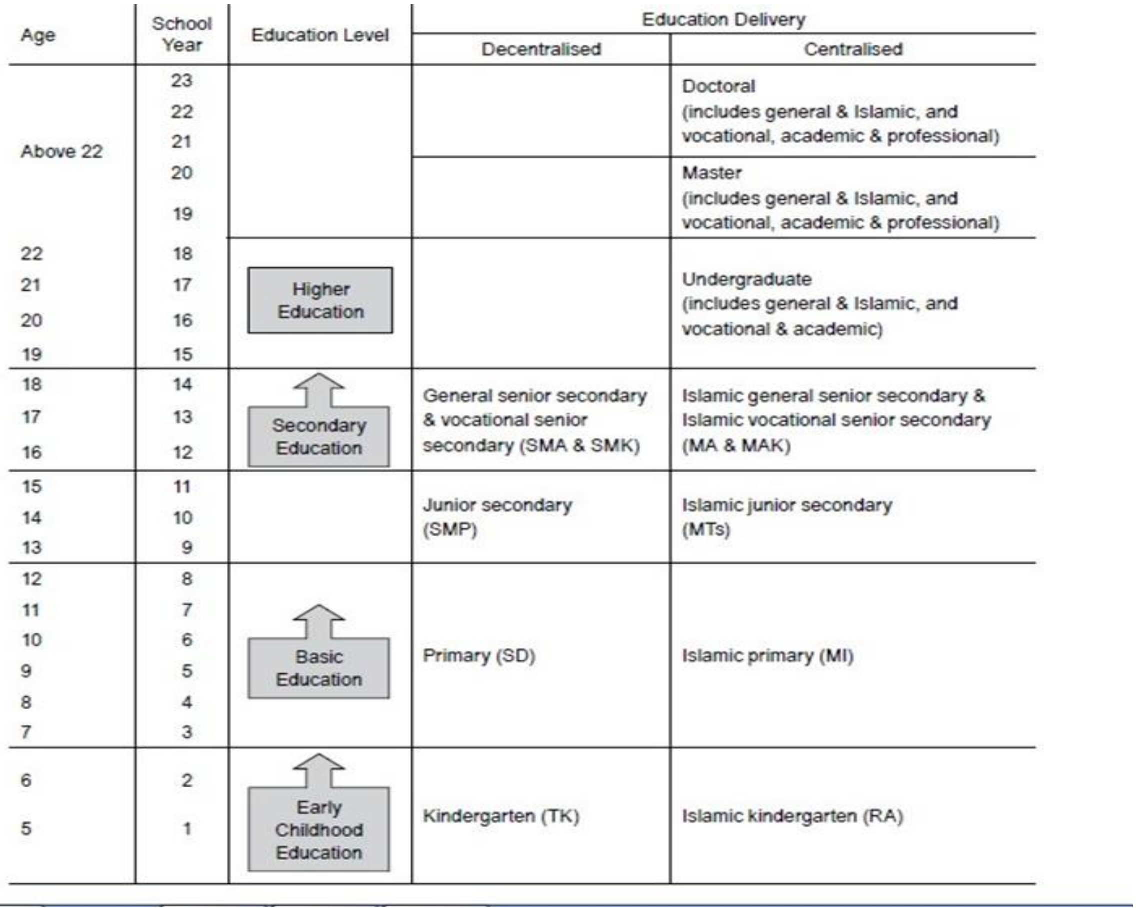

Fig. 3. Indonesia Education System

Table 2. Distribution of population, students, educational institutions and teachers, by age and level of education, Indonesia, 2013

Age Group	Population (millions)	Education Level	Students (Millions)	Number of Institutions	Teachers/ Professors
3-6	18.52	Early childhood	10.60	162 753	517 858
7-12	26.04	Primary	26.77	148 272	1 682 263
13-15	12.04	Junior Secondary	9.65	35 527	587 610
16-18	12.57	Senior Secondary	8.46	22 780	452 041
19-23	21.19	Tertiary	5.82	3 189	209 830
Total	01.09		61.30	372 521	3 449 602

Source: (Kementrian Pendidikan dan Kebudayaan, 2013)

The long historical and contemporary impact of Western academic models, practices and orientations on Asian universities in such countries as India, Malaysia, Indonesia and Singapore shaped the nature of higher education systems in these countries. The Japanese colonial impact in Korea and Taiwan is also significant and an interesting variation on the colonial theme. Several Asian countries, including Thailand, Japan and China were not formally colonized, but the mixture of influence on the academic institutions that has developed in these countries reflects considerable Western influence. Contemporary factors such as the international knowledge system, the numbers of students studying in Western nations and patterns of scientific interaction also have a major impact on the growth of universities in Asia (Education, 2010).

Education has been developing on Asian such as Hongkong, Japan, Malaysia, Singapore, Taiwan, Indonesia and else (Grossman, 2004). The Indonesian education system is immense and diverse. With over 60 million students and almost 4 million teachers in some 340 000 educational institutions, it is the third largest education system in the Asia region and the fourth largest in the world (behind only the People's Republic of China, India and the United States). Two ministries are responsible for managing the education system, with 84% of schools under the Ministry of Education and Culture (MOEC) and the remaining 16% under the Ministry of Religious Affairs (MORA). Private schools play an important role. While only 7% of primary schools are private, the share increase to 56% of junior secondary schools and 67% of senior secondaries, average of education levels classified by age in Indonesia (Figure 3).

Table 3. Inovation Biotechnology to Supporting SDGs

	How Biotechnology Could Solve
End Hunger	Food security is priority on international issues (Sahn, 2015) More-efficient animal production and meat substitutes are needed. Chicken is more sustainable than beef, owing to lower greenhouse-gas emissions and water needs. Genomic technologies will need to be applied to more foods, as they have been to dairy cattle, chicken, salmon, tilapia, rice and banana. Farmed seafood production must be boosted and will require new vaccines and molecular diagnostics to reduce antibiotic use, as well as sources of protein-rich feed.
Ensure Healthy Lives	Sustainable on medicine has been developing (McKee, 2018) World Health Organization has developed a framework for health system that comprise six building blocks (World Health Organization, 2010). Sustainable medicine can be learned from the past (World Health Organization, 2010) and the future medicine such as microRNA polymorphisms (Mishra & Bertino, 2009), production of semi-synthetic artemisinin from microbially sourced artemisinic acid is an early success story for combining metabolic engineering and synthetic biology in the commercial production of drugs against malaria
Water and Sanitation for All	In developing countries, 90% of sewage and 70% of industrial wastes are discharged without treatment. Advances in biological wastewater treatment, including phosphorus removal and nitrification, hold potential if implemented more widely. Small, modular systems should be spread to remote communities, and large, intensive plants can cater for city-sized populations.
Clean Energy	Most developing countries have unreliable energy systems. Burning wood or manure leads to health problems, premature deaths and deforestation. Decentralized, modern solutions that combine bioenergy with other renewables are needed. For example, an Indian social enterprise has implemented dairy and biogas production and local mini-grids electrified by biogas from waste or by eco-briquettes
Soil Remediation	Using AM fungal communities and the sustainability of soil remediation in Daliuta coal mining subsidence area(Bi et al, 2018), electrokinetic remediation for the removal of organic contaminants in soils (Cameselle & Gouveia, 2018) and other biotechnology remediation treatment for soil (Kremer, 2017)
Education Quality	Bioethical has been developing in teaching biology to make education quality well (Iancu, 2014) and other developing such as lessons learned as a student of craniofacial biology: What this might mean for orthodontic professional education and clinical practice in the 21st century (Slavkin, 2017). Several research would to know the key of cell biology and science education (Miller, 2010) and else, this paper find biology science and education that supporting SDGs

The Indonesian education system has to attend the needs of a large, growing, diverse and widely dispersed population and with great disparity in enrolment rates between regions. Table 2 shows the current distribution of people, students, institutions and teachers at the various educational levels (Finkelstein, 1951) and evey single education level have biology science and education system that supporting SDGs.

New Biology Science and Education

In the 1800s, those who studied the living world were called "naturalists" and they were highly interdisciplinary, combining observations from biology, geology, and physics to describe the natural world. In this 200th anniversary year of Darwin's birth, after decades of highly productive specialization, the study of life is again becoming more interdisciplinary, by necessity combining previously disparate fields to create a "New Biology." The essence of the New Biology is re-integration of the subdisciplines of biology, along with greater integration with the physical and computational sciences, mathematics, and engineering in order to devise new approaches that tackle traditional and systems level questions in new, interdisciplinary, and especially, quantitative ways (Fig 4).

New Biology relies on integrating knowledge from many disciplines to derive deeper understanding of biological systems. That deeper understanding both allows the development of biology-based solutions for societal problems and also feeds back to enrich the individual scientific disciplines that contributed to the new insights. It is critically important to recognize that the New Biology does not replace the research that is going on now; that research is the foundation on which the New Biology rests and on which it will continue to rely. If we compare our understanding of the living world to the assembly of a massive jigsaw puzzle, each of the subdisciplines of biology has been assembling sections of the puzzle. The individual sections are far from complete and continued work to fill those gaps is critical. Indeed, biological systems are so complex that it is likely that major new discoveries are still to be expected, and new discoveries very frequently come from individual scientists who make the intellectual leap from the particular system they study to an insight that illuminates many biological processes. The additional contribution of the New Biology is to focus on the connections between the partially assembled puzzle sections and dramatically speed up overall assembly (Yamamoto et al, 2010)

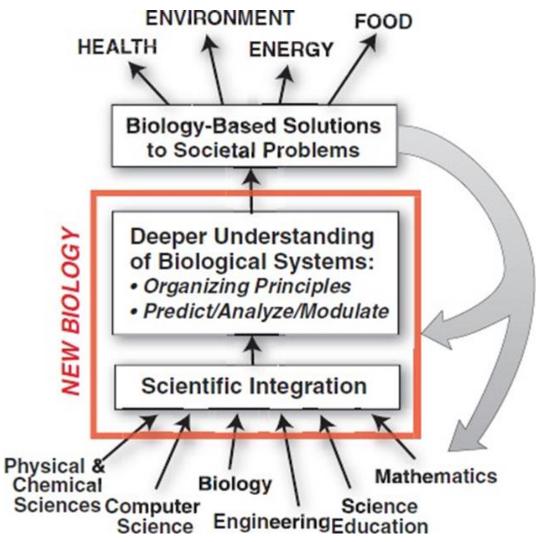

Fig. 4. New Biology for 21th Century

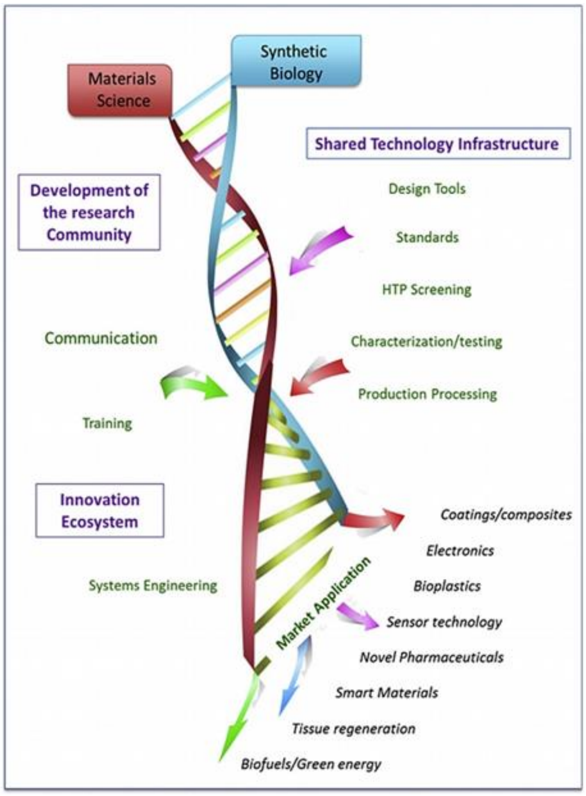

Fig. 5. Synthetic Biological Materials

New biology can solve the problem about hunger use biotech (Keats, 2012), use synthetic biological material to find new advance material (Le Feuvre & Scrutton, 2018). New biology could driving intersectorial, interdisciplinary and international connectivity, and the leveraging of existing investments in synthetic biology, materials science, allied science and technology areas, are the major challenges in delivering the Materials from Biology vision (Fig.5).

This is alongside a need to establish early stage partnerships with industry to define unmet needs in advanced materials and to maintain Unification of these fields will create major opportunities for new materials discovery, their sustainable and affordable manufacture and continued engagement from early-stage discovery and development, through to manufacturing delivery and commerci- alisation. application to unmet needs for industry (Le Feuvre & Scrutton, 2018).

Fig. 6. Health System Building Blocks (World Health Organization, 2010)

Biology Science and Education to Supporting SDGs

More than 40 nations have attended Global Economic Summit to making bioeconomy work for SDGs (Global Economic Summit, 2015). Bioeconomy based an economic by biology and bioscience to develop around US$ 2 trillion of product in agriculture, food, bioenergy, biotechnology and green chemistry were exported worldwide in 2014 (El-Chichak et al, 2016) . These sectors are central to at least half of the UN Sustainable Development Goals (SDGs), from food security to ensuring energy access and health. But conflicting national priorities make it hard to align bioeconomy policies to meet the SDGs on a global scale. Inovation on the bioeconomy that Scoring SDGs could see on Table 3.

4. CONCLUSION

Biology education and science could supporting sustainable development goals especially for end hunger, biology education and science can make security food, More-efficient animal production and meat substitutes are needed. Chicken is more sustainable than beef, owing to lower greenhouse-gas emissions and water needs, ensure healthy lives using development of biological medic, to distribution water and sanitation for all, keep clean energy, soil remediation and developing education quality.

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