Environmental Chemistry Education for Encouraging the Willingness to Participate in Sustainable Consumption of Food

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Abstract: Sustainable consumption of food can be achieved by applying the nutritious, diverse, and balance (NUDIBA) food consumption in daily life. Indonesian Ministry of Health promotes the NUDIBA food consumption as the integrated program for Movement of Healthy Society of Indonesia which had been started since 2014. This paper is a literature review on environmental chemistry education in higher education to achieve sustainable consumption of food by encouraging the willingness to participate. The aim of this literature review is to propose environmental chemistry education for encouraging the willingness to participate in young adults' sustainable consumption of food. The core topic of environmental chemistry is the importance of environmental chemistry knowledge and skill to preserve and maintain the biodiversity to achieve food security by sustainable consumption of food. The learning approach uses daily (healthy) life needs of food as the problem based learning. The target of environmental chemistry education is the under-graduate students who have development tasks as young adult.The hypothesis is healthy life achievement through NUDIBA food consumption will encourage the willingness to participate of young adults in sustainable consumption.

1 INTRODUCTION

The under-graduate students of Chemistry Education Study Program are the future chemistry teacher as well as a young adult who are the future generations of a nation which is the Republic of Indonesia. The Republic of Indonesia is a democratic country which needs young adults to be an active civil society. The young adults have a significant period in their life for becoming an engaged citizen (Reichert, 2017).

Engaging the young adult to be an active civic society need a supportive effort such as encouraging their willingness to participate (Schelbe et.al., 2015). Education can deliver the supportive effort to engage young adult citizenship (Keating & Janmaat, 2015).Van Deth (2016) described individual resources-equipment based on education, income, and social position affects people's willingness to participate politically.

Specifically, education enhances participation by developing skills that are relevant to politics such as the ability to speak and write, the knowledge of how to cope in an organizational setting (Persson, 2015). So that, individuals with higher education participate to a larger extent in political activities because of their civic skills and political knowledge are better than individuals with lower education.

The main idea of this paper is environmental chemistry education to encourage young adults' willingness to participate by developing sustainable consumption of food to achieve food security (first target of SDGs).Environmental chemistry education develops understanding what happend in nature so it will maintain the capability of students to predict the fate and chemical reactions that natural compounds and artificial pollutans may undergo (Ibanez et al., 2010).

Ibanez et al. (2010) explains that environmental chemistry knowledge becomes fundamental to understand the interaction between what happens in nature and the chemical reaction to predict what may happen to certain compounds if discharged into the environment, and if organism (human or not) come into contact with them (Ali, Khan, and Ilahi, 2019). Gasper, Shah, and Tankha (2019) defined sustainable consumption related to sustainable management and efficient use of natural resources and environmental management of chemicals and all wastes. It also ensures universal access to relevant information and awareness for sustainable development and lifestyle, or reduce food losses, chemical, and waste pollution

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and waste generation. So, environmental chemistry education should encourage students to elaborates their knowledge as the fundamental to participate in preserving the natural resources and environment, especially related to food security.

Since 2014, Health Ministry of Indonesia hadprovided the balanced nutritionguidelines to support the sustainable consumption of food through the nutritious, diverse, and balance (NUDIBA) eating (Kementrian Kesehatan, 2014). The guidelines help people to choose and decide the right and balanced nutritions based on their physical and psychological needs. Environmental chemistry knowledge can be the fundamental of making the choice and decision.

Therefore, as the future chemistry teacher, it is important to be able to elaborate the environmental chemistry knowledge to support the healthy (Fadila and Kurniawati, 2018) and sustainable eating habits to achieve the quality of human resources of Indonesia (Cornia and Adriani, 2018). The elaboration is also important to practice the problem-based learning approachin schoolthat enhances students' problem-solving skills in chemistry (Valdez and Bungihan, 2019).

This paper aims to propose environmental chemistry education to encourage the willingness to participate in young adults' sustainable consumption of food. The young adults mean the under-graduate students (higher education) who age between 20-25 years old.

2 LITERATURE REVIEW

This literature review focus on young adults who are studying chemistry teacher education and becoming future active participants in ecologically, economically, or societally sustainable consumption of food. The environmental chemistry is proposed in line with Burmeister and Eilks (2013) to support a strong sustainable movement in an industrialized society by maintaining the overall supply levels of energy and goods, and at the same time, decreasing the amounts of environmentally hazardous substances and raw material consumption.

The chemistry knowledge as the core domain defines the knowledge characteristics and production processes of chemistry as learning goals and outcomes. Together with the teacher in class, young adults as learners ask questions about what concepts and methods of chemistry are relevant to sustainable consumption of food; how chemistry knowledge processes are generated to analyze the environment impact; how to adapt and apply relevant chemistry theory to produce and consume food ecologically sustainable; what environmental standards and criteria drive knowledge processes in chemistry; and how do we bond the chemistry knowledge with the behavior of food sustainable consumption (Erduran and Kaya, 2019).

2.1 Environmental Chemistry Education

Wright (2004) explained environmental chemistry as a study of human interaction with the environment regarding the source, reactions, transport, effect and fate of chemical species in the air, water, and soil, and the effect of human activity upon these circumstances. Environmental chemistry is a multi-disciplinary science involving chemistry, physics, life science, agriculture, medical science, public health, sanitary engineering, etc.

Environmental chemistry education becomes an important study when the exponential growth of the human population causes extra-large disruption to the natural environment to support human living and impacts the carrying capacity of the earth (O'neill, 2017). In other words, we can define environmental chemistry as a study of the role of chemical elements in the synthesis and decomposition of natural materials of all kinds, including the changes especially brought about by human actions.

Ibanez et al. (2010) explained that the fundamental of environmental chemistry to enhance the knowledge so human can understand what happens in nature and predict the fate and the chemical reactions that may undergo between natural compounds and artificial pollutants. Further, the knowledge will support the way of thinking to understand the interactions so that predict what may happen to certain compounds if discharged into the environment and if organism (human or not) come into contact with them.

Virtually, Hites and Raff (2013) stated that environmental chemistry can provide data input for risk assessment and treatability studies, and determine the required level of environmental quality or control needed in a system. The data are particularly important for making cost-effective decisions about discharge treatments or risk-management decisions or determining environmental-impact mitigation or remediation measures.

Environmental chemistry education drives individual green chemistry-based thinking and action (Mudhoo & Sharma, 2010) that support political, economic, and social developments. The developments are highly interactive and have

desireable or undesirable consequences from the viewpoint of energy consumption, ecological, and environmental degradation.

Environmental chemistry education proposed in this literature review is similar to the research of green chemistry conducted by Karpudewan, Ismail & Roth (2012) in Malaysia to improve science, especially teacher, education. Green chemistry in the research leads to a potential changing relevant to chemistry concepts, attitudes, pro-environmental values, and motivations for acting pro-environmentally. Deeper, green chemistry allows students to participate in decision making over real issues in their everyday life, and drive them to contribute to global environmental problems by acting appropriately on local matters.

This literature review intends to promote environmental chemistry education for the science teacher to build and sustain lively scientific communities as a potential contribution to bring about sustainable practices related to the environment and environmental health so that the teachers can address global problems and, at the same time, maintain the high level of scientific literacy among the general public. The environmental chemistry education should be able to encourage the students to actively participate in decision making, especially over the sustainable consumption of food issues based on their everyday life at home, schools and anywhere they do various kinds of activities, supported by a teacher role who has a high levels of chemistry literacy related to environmental chemistry.

As long-life learning, environmental chemistry education which promotes sustainable development through the sustainable consumption of food should be the aims and values, practices, methods and knowledge that create a belief within the science teacher to improve and sustain their role along the chemistry learning process in school. Erduran & Kaya (2019) defined the beliefs support the complex epistemic ideas on science teachers through the everyday scenario, using analogies, and visual representations to communicate their ideas.

Environmental chemistry-based beliefs become the core of chemistry philosophy internalization that leads to science teachers' identity development. This identity will improve the chemistry interest between teachers that impact to chemistry teaching especially in the classroom and to the society where they get involved (Erduran and Kaya, 2019).

2.2 The Willingness to Participate

Individual willingness to participate is an important means for shifting the pace of sustainable consumption of food at the local level. Kalkbrenner & Roosen (2016) defined participation as a process that happens within persons to take part in decision making in institutions or programs or environments that affect them. The willingness to participate can be initiated by high concern over certain issues that become part of someone's beliefs.

Lilleker and Koc-Michalska (2017) stated that intrinsic motivation is a primary driver of individual willingness to participate, though it is still argued as the conventional acts of political participation. Beliefs are the part of intrinsic motivation together with self-efficacy, empowerment, and feeling of influencing decision-makers. Further, willingness to participate is also driven by extrinsic motivations, especially the mobile tactics (online and offline) with its mediating effect. The extrinsic motivations have the strongest explanatory power independent of the sphere of activity even impact the lack of meaning to the individual intrinsic motivations. The research suggested encouragement by non-governmental campaigning organizations encounter social media users to perform simple acts in support of non-contentious causes.

A classroom can be the media for developing the students' willingness to participate in sustainable consumption of foodthrough civic knowledge and involvement in decision making (Eckstein, Noack, & Gniewosz, 2012; Castillo, *et.al.*, 2015; Persson, 2015). Environmental chemistry-based literacy of science teacher can mitigate the gap of political participation in the classroom by improving the civic knowledge and implying sustainable consumption of food problem-based learning (Karpudewan et al., 2012; Persson, 2015; Valdez and Bungihan, 2019). Dabholkar (2015) stated that learning process in class can support the civic knowledge improvement by internalizing aims and values, practices, methods and knowledge of sustainable consumption of food.

Van Deth (2016) described political participation as an individual's movement that becomes formal institutions with more power in decision making. If environmental chemistry-based learning, especially for science teachers education, to support sustainable development is integrated into the higher education curriculum, Clifford and Montgomery (2015) stated that the individual movement over sustainable consumption of food will become the institutional learning outcomes which influence the political participation at the local level.

2.3 Sustainable Consumption of Food

Ensuring sustainable consumption and production patterns is the Target 12 of SDGs which includes 8 specific targets and 3 targets related to Means of Implementation (Gasper, Shah, and Tankha, 2019). The sustainability is mainly viewed through the lens of production efficiency related to the use of natural resources, food production and supply related losses, management of chemicals and wastes, sustainable corporate practices and reporting, and sustainable public procurement.

Virtually, environmental chemistry education at schools directly can not achieve the Target 12 of SDGs, but it intends to develop pro-environment behaviors by reducing food waste at the consumer level and promote voluntary consumer action to ensure universal access to information for sustainable lifestyles. Environmental chemistry will become the strong language to emphasizes voluntary and indirect policy approaches for achieving sustainable consumption and production patterns, and promote sustainable public procurement or provide people with relevant information and awareness as a purely voluntary initiative.

Society identifies sustainable consumption of food as green product consumption. The findings of Kumar and Ghodeswar (2015) explained that the willingness to participate in sustainable consumption is to nurture human helath (Willett, *et.al.*, 2019) and support environmental protection driven by the realization of environmental responsibilities, inclination towards searching green product-related information and learning about green products. The decision to purchase green products is also supported by the existence of environmental friendliness of companies and social appeal.

Sustainable consumption of food means access is wide open for people to get the desirable and needed food and provide various choices. The perception and preferences of local food become important factors to achieve the sustainable consumption of food (Feldmann and Hamm, 2015). The awareness of food origin will raise the perception and preferences of local food.

Environmental chemistry education should focus on science teachers' perception development that leads to the initiative of sustainable procurement of food. The perception will be a positive determinant for building the identity of a teacher's role in the classroom.This identity continuously constructs a sustainable system in food consumption along the learning process in class.

One topic related to sustainable consumption of food is about biodiversity on our plate to achieve the ideal health, physically and psychologically, through NUDIBA (nutritious, diverse, and balance) eating. Since 2014, the Health Ministry of Indonesia had been promoting this NUDIBA eating as a positive determinant for human resources development in Indonesia. The learning outcome of environmental chemistry is to improve the chemistry knowledge and literacy to be able to choose and decide the right and balanced nutritious based on physical and psychological needs.

2.4 Young Adults

The targets of this literature review are the young adults as under-graduate students (higher education) who age between 20-25 years old. Jessor, Donovan, and Costa (1994) described that the young adulthood is a time of new experiences and expanded responsibilities. Young adults may enter the labor market for the first time, commit to themselves to political and religious philosophies that shape their attitudes and guide their behavior, and dissolve old friendship ties and establish new ones. Young adult participants engages a variety of life domain and reveals a variety of outlooks and life-styles. Their political, religious, and moral viewpoints and attitudes reflected a mix of liberalism and conventionality.

Nagaoka et al. (2015) stated that preparing young adult for meaningful, productive futures requires coordinated efforts and intentional practices by adults across youth inhabit ona daily basis. The preparation has four foundational components, they are self-regulation, knowledge, mindsets, and values.

Young adult has a significant period in life for becoming an engaged citizen (Reichert, 2017) who is actively participate in political issues. The result stated the young adult conceptions of good citizenship as engaged or duty-based participation.

Environmental chemistry knowledge will be the fundamental of thinking for young adults to acquire information about healthier products such as for healthy tooth wear and other oral health care (Verploegen and Schuller, 2019). Deeper, knowledge of environmental chemistry will rigor the science of conservation to develop youth-focused community and citizen science which are the agents for conservation and environment (Ballard, Dixon, and Harris, 2017).

3 CONCLUSIONS

Environmental chemistry education for science, especially chemistry, teachers' education should be able to develop beliefs within the teachers as the identity of science teaching in class. The beliefs will grow up become intrinsic motivation for teachers to participate in sustainable consumption of food. As stated by Erduran and Kaya (2019) that environmental chemistry-based beliefs is the core for chemistry philosophy internalization to lead the teachers' identity development which improve the chemistry interest and impact the chemistry learning in class and the society they get involved.

The chemistry teachers whose belief based on environmental science will be able to create a daily life-based learning and multi disciplinary thinking so the chemistry learning at school can be the media for developing the students' willingness to participate in sustainable consumption of food through civic knowledge (Eckstein, Noack, and Gniewosz, 2012; Persson, 2015). In line with Castillo et al. (2015) that classroom can encourage the students to involve in decision making.

This literature review intends to approach the young adults who will be the chemistry teacher and the environmental chemistry is one of subjects in the curriculum of chemistry education. Environmental chemistry-based literacy can mitigate the gap of political participation in class (Karpudewan et al., 2012; Valdez& Bungihan, 2019) and develop the knowledge to acquire information about healthier products (Verploegen and Schuller, 2019) include the aims and values, practices, and methods of sustainable consumption of food (Dabholkar, 2015).

Hopefully, at the end of the learning process, the knowledge and literacy of environmental chemistry become the rigorous science to develop youth-focused chemistry teachers as agents for conservation and environment (Ballard, Dixon, and Harris, 2017). As part of society, chemistry teachers can also involve in community education to support the sustainable consumption of food by enhancing human health and protecting the environment through the implementation of NUDIBA eating in daily life andactively promotion/socialization towards the society. This situation will bring movement to achieve the food security and human development index.

REFERENCES

Ali, H., Khan, E. and Ilahi, I., 2019. Environmental chemistry and ecotoxicology of hazardous heavy metals: environmental persistence, toxicity, and bioaccumulation. *Journal of Chemistry*, *2019*.

Ballard, H. L., Dixon, C. G., & Harris, E. M. 2017. Youth-focused citizen science: Examining the role of environmental science learning and agency for conservation. *Biological Conservation*, *208*, 65-75.

Burmeister, M., & Eilks, I. 2013. Using Participatory Action Research to develop a course module on Education for Sustainable Development in pre-service chemistry teacher education. *CEPS journal*, *3*(1), 59-78.

Castillo, J.C., Miranda, D., Bonhomme, M., Cox, C., & Bascopé, M. 2015. Mitigating the political participation gap from the school: The roles of civic knowledge and classroom climate. *Journal of Youth Studies*, *18*(1), pp. 16-35.

Clifford, V. and Montgomery, C., 2015. Transformative learning through internationalization of the curriculum in higher education. *Journal of Transformative Education*, *13*(1), 46-64.

Cornia, I.G., & Adriani, M., 2018. Hubungan antara asupan zat gizi makro dan status gizi dengan kebugaran jasmani mahasiswa ukm taekwondo. *Amerta Nutrition*, *2*(1), 90-96.

Dabholkar, P. A. 2015. How to improve perceived service quality by increasing customer participation. In *Proceedings of the 1990 academy of marketing science (AMS) annual conference*, 483-487. Springer, Cham.

Eckstein, K., Noack, P. and Gniewosz, B., 2012. Attitudes toward political engagement and willingness to participate in politics: Trajectories throughout adolescence. *Journal of Adolescence*, *35*(3), 485-495.

Erduran, S., & Kaya, E., 2019. *Transforming teacher education through the epistemic core of chemistry*, Springer. UK.

Fadila, I., & Kurniawati, H., 2018. Analisis pengetahuan gizi terkait pedoman gizi seimbang dan kadar hb remaja puteri. *BIOTIKA Jurnal Ilmiah Biologi*, *16*(1), 12 – 19.

Feldmann, C., Hamm, U., 2015. Consumers' perceptions and preferences for local food: A review. *Food Quality and Preference*, *40*, 152-164.

Gasper, D., Shah, A., & Tankha, S., 2019. The framing of sustainable consumption and production in SDG 12. *Global Policy*, *10*, 83 – 95.

Hites, R.A., & Raff, J.D. 2013. *Elements of environmental chemistry*. John Wiley & Sons.

Ibanez, J. G., Hernandez-Esparza, M., Doria-Serrano, C., Fregoso-Infante,A., & Singh, M.M., 2010. *Environmental chemistry: fundamentals*. Springer Science & Business Media.

Jessor, R., Donovan, J. E., & Costa, F.M., 1994. *Beyond adolescence: Problem behaviour and young adult development*, Cambridge University Press. Cambridge.

Kalkbrenner, B.J., & Roosen, J., 2016. Citizens' willingness to participate in local renewable energy

projects: The role of community and trust in Germany. *Energy Research & Social Science*, *13*, 60 – 70.

Karpudewan, M., Ismail, Z., & Roth, W.M., 2012. Ensuring sustainability of tomorrow through green chemistry integrated with sustainable development concepts (SDCs). *Chemistry Education Research and Practice*, *13*(2), 120-127.

Keating, A., & Janmaat, J.G., 2015. Education through citizenship at school: Do school activities have a lasting impact on youth political engagement? *Parliamentary Affairs*, *69*(2), 409-429.

Kementrian Kesehatan, R.I., 2014. *Pedoman gizi seimbang*, Kemenkes RI. Jakarta.

Lilleker, D.G. and Koc-Michalska, K., 2017. What drives political participation? Motivations and mobilization in a digital age. *Political Communication*, *34*(1), 21 – 43.

Mudhoo, A., & Sharma, S.K., 2010. *Green chemistry for environmental sustainability*, Boca Raton. CRC Press.

Nagaoka, J., Farrington, C.A., Ehrlich, S.B., & Heath, R.D., 2015. *Foundations for young adult success: A developmental framework. Concept Paper for Research and Practice*. University of Chicago Consortium on Chicago School Research. 1313 East 60th Street, Chicago, IL 60637.

O'neill, P., 2017. *Environmental chemistry*, Routledge. London.

Persson, M., 2015. Education and political participation. *British Journal of Political Science*, *45*(3), 689-703.

Reichert, F., 2017. Young adults' conceptions of 'good'citizenship behaviours: A latent class analysis. *Journal of Civil Society*, *13*(1), 90-110.

Schelbe, L., Chanmugam, A., Moses, T., Saltzburg, S., Williams, L.R., Letendre, J., 2015. Youth participation in qualitative research: Challenges and possibilities. *Qualitative Social Work*, *14*(4), 504 – 521.

Valdez, J.E., & Bungihan, M.E., 2019. Problem-Based Learning Approach Enhances the Problem Solving Skills in Chemistry of High School Students. *Journal of Technology and Science Education*, *9*(3), 282 – 294.

Van Deth, J.W., 2016. Political participation. *The International Encyclopedia of Political Communication,12.* doi:10.1002/9781118541555.wbiepc171.

Verploegen, V.J.N., & Schuller, A.A., 2019. Erosive tooth wear: Knowledge among young adults and their preferred information sources. *International journal of dental hygiene*, *17*(1), 85-92.

Willett, W., Rockström, J., Loken, B., Springmann, M., Lang, T., Vermeulen, S.,& Jonell, M., 2019. Food in the Anthropocene: The EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet*, *393*(10170), 447 – 492.

Wright, J., 2004. *Environmental chemistry*, Routledge. London.