Green Technology Awareness on Food Processing Among Students of Prospective Agricultural Vocational Teachers

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Abstract—**Current trend in food sector is the adoption of green technologies to realize towards a sustainable society and greener economy. Agricultural vocational teachers who prepare students to work in food industry need to master green technology on food processing. This study aimed to identify students' awareness and learning-need as prospective teacher of agricultural vocational school regarding green technology in food processing. A total of 107 students of prospective agricultural vocational teacher participated in the survey. Students fill out a questionnaire of green technology on food processing with 8 items measuring awareness of green technology terms. Descriptive statistics was used to analyze the data. The results showed that most students lack awareness of the terms and central issues, such as life cycle assessment, carbon footprint, non-thermal food processing, waste management hierarchy as well as green technology itself. Students stated that they were most familiar with the term of green packaging. As many as 78.5% of respondents stated the need for prospective agricultural vocational teachers to learn green technology on food processing. This finding implies the importance of green technology on food processing to be integrated into the curriculum of agricultural vocational high school teachers' education.**

Keywords—*students awareness, green technology on food processing, prospective agricultural vocational teachers*

I. INTRODUCTION

UNESCO's mission for TVET (technical and vocational education and training) in its mid-term strategy 2021-2023 is to promote future oriented TVET that is responsive to sustainable development and labor market demands [1]. TVET is expected to be able to respond to the demands of the economy and society by facilitating young people to develop the skills needed for decent work, moreover young people are key players in the transition to a sustainable society and greener economy.

Meanwhile, economy and industrial activities, including the food industry, are currently shifting towards green economy environmental and sustainability issues [2]. Thus, the concept of green manufacturing processes in the food industry is currently a hot topic of research in the multidisciplinary fields of chemistry, biology, and applied technology to reduce waste, use sustainable materials while ensuring food quality and safety to consumers [3].

In Indonesia, vocational high schools (SMK) as senior secondary vocational education institutions, focus on developing students' expertise in a particular field. Agricultural food processing technology is one of the competencies offered in SMK where students are required to be ready to work in the food industry. Graduates must have sustainable skills required the industry, namely green skills [4]. However, green skills of agricultural vocational students in West Java, Indonesia are still not in accordance with the needs of industry, so they need to be improved to be competitive [5].

To prepare students with green skills, vocational teachers have an important role [6]. They must have a high level of awareness [7] and be able to train it to students [8]. Furthermore, teachers play an important role in promoting education for sustainable development, as one of the agreements in Berlin Declaration on Education for Sustainable Development (ESD) - The UNESCO World Conference on ESD, 17-19 May 2021. However, agricultural vocational teachers in West Java, Indonesia had less knowledge of green skills [9].

One of the elements of green skills is innovation skills such as identifying opportunities and developing creative strategies to support green growth [4]. In addition, mandate of the Berlin Declaration on ESD (2021) was to adapt green technology as a manifestation of the application of technology that is responsible, safe, fair, and inclusive.

Current trend in food sector is the adoption of green technologies lead to reduce energy used and environmental footprint, reduction of process-induced toxins in food and the environment, and waste generation along the food supply chain [10]. This was driven by increasing consumer awareness of the potential negative impact of food processing on human health

and the environment [11]. Therefore, vocational teacher education students for agriculture need to master green technology used in the agricultural sector. This study aimed to identify student awareness as prospective agricultural vocational teachers regarding green technology on food processing.

II. METHODS

A. Measurement of Awareness

Awareness is defined as a conscious of being aware of an idea or event [12] or the condition of being conscious that something exists [13]. A person's awareness of an idea or event is the result or implication of hearing or touching it through various ways, such as conversation, discussion, watching, reading, listening to news, and others. In this study, awareness of green technology on food processing was defined as students' familiarity to the concept as an implication of hearing or reading from any source. The construct was measured through awareness of the terms and issues surrounding green technology on food processing [14,15]. It was assessed by asking students to indicate their familiarity with eight green technology terms and ideas on a dichotomous scale, i.e., by asking them to state whether they had heard of the words or not. In addition, students were asked to fill in open ended questions related to awareness of green technology on food processing. Students were also asked to rate their level of need to learn of green technology concepts on food processing on a 5-point Likert scale.

B. Sample

The respondents were 107 students who came from a study program providing vocational education for agricultural vocational teachers at one of the public universities in Indonesia. Sampling used a combination of random and purposive sampling techniques. A criterion was set to select respondents in which they must be actively registered students.

C. Instrument

The instrument used to collect data was a questionnaire of the awareness of green technology on food processing which developed in four parts. The first section asked the demographic information of the respondents, such as gender and year of study. The second part contained 8 dichotomous items that measure awareness of green technology terms on food processing. The item only asks whether the respondent has heard or not heard of the following terms and ideas: SDGs related to food processing, LCA (life cycle assessment), green technology, green packaging, waste management hierarchy, greenhouse gas emission, carbon footprint, and non-thermal food processing. The third part was an open-ended question related to awareness of green technology on food processing and. The last part contained preferences regarding the need for mastery of green technology concepts on food processing for prospective of agricultural vocational teachers. Respondents were asked to rate their preferences on a 5-point Likert scale

ranging from very unnecessarily to very necessary and share their opinion about which course that they suggest green technology concept to be integrated with. The statements in the questionnaire were formulated from an extensive review of the literature on green technology on food processing.

D. Data Collection and Analysis

The questionnaire of a google form link was distributed online via WhatsApp group with the help of lecturers. Respondents were given several days to respond. Several follow-up actions, namely text messages and phone calls, were used to ensure a high response rate. Data were analyzed using a combination of descriptive and inferential techniques. Responses to eight dichotomous items measuring green technology vocabulary awareness were scored 1 for "Yes" and "0" for "No." Scores were summed and displayed in terms of frequency and percentage to show the distribution of students with and without vocabulary awareness. This was first done for all respondents to indicate general level of awareness, Responses to Likert-type self-assessment items on the need of learn to green technology were analyzed using simple frequency and percentage calculations.

III. RESULTS AND DISCUSSION

A. Demographic Information of the Respondents

Research results begin by displaying the demographic information of the respondents (n=107). Table 1 shows the respondent's information variables on gender, class, and age.

TABLE I.   DEMOGRAPHIC INFORMATION OF THE RESPONDENTS

Variables	Frequency (f)	Percentage (%)
Gender		
Male	12	11.21
Female	95	88.79
Age (years old)		
22	8	7.48
21	24	22.43
20	32	29.91
19	27	25.25
18	16	14.95
College class		
Class of 2021	16	14.95
Class of 2020	29	27.10
Class of 2019	33	30.81
Class of 2018	29	27.10

Most respondents were female (88.79%), while the rest were male. It shows female enthusiasts and population dominate in vocational education for agricultural vocational teachers at the university where the research took place. The age of the respondents varied from 18-22 years old and was dominated by students aged 20 years old (29.91%). This is in accordance with the origin of the respondents based on the largest college class participation from class of 2019 (30.81%), which has an average age of 20 years old.

B. Green Technology Awareness on Food Processing Among Students of Prospective Agricultural Vocational Teachers

The 8 terms refer to the principles of green food processing (including life cycle assessment, and carbon footprint) consisting of SDGs Related to Food Processing, Non-Thermal Food Processing, Green Packaging, Waste Management Hierarchy, Carbon footprint, Greenhouse Gas Emissions, Life Cycle Assessment, and Green Technology. Fig. 1 shows the percentage of respondents' familiarity with 8 green technology terms of food processing.
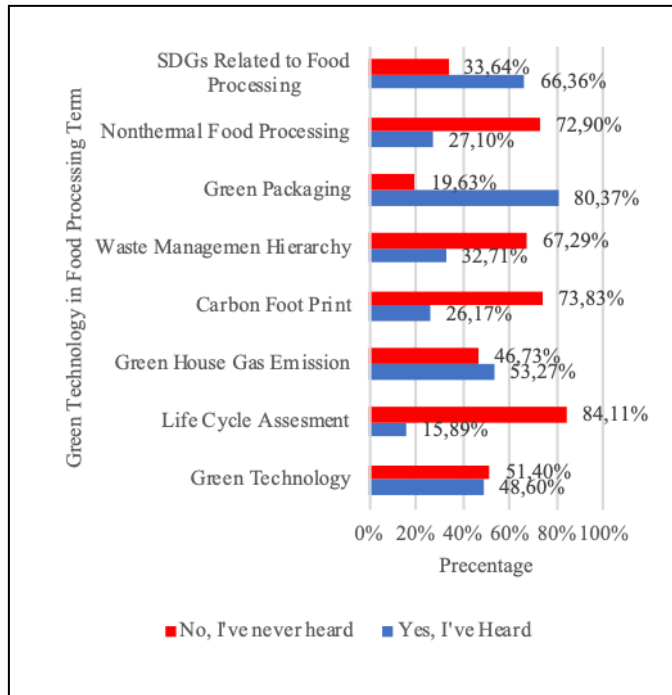

Fig. 1. Percentage of respondents' familiarity with 8 green technology terms of food processing.

Respondents' answers indicate the lack of knowledge and awareness of students of prospective agricultural vocational teachers on 8 terms of green technology awareness on food processing. The least known terms lie in important terms and issues such as Life Cycle Assessment (15.89%), Carbon Footprint, Nonthermal Food Processing (27.10%), Waste Management Hierarchy (32.71%), and Green Technology (48. 60%). Meanwhile, only a few terms that are widely known include Green Packaging (80.37%) and SDGs related to Food Processing (66.36%), while the rest are only known by 50-40% of respondents. However, some respondents who claimed to be aware of Green Packaging and SDGs related to Food Processing did not meet the expected answers.

R4 and R60 *"Food packaging made from natural ingredients"*

R105 *"packaged food and beverages"*

Those answer were not in line with the definition of green packaging, namely packaging that can reduce the impact of waste and pollution, as well as promote sustainable development [16]. While other respondents elaborating green packaging as simply as translating it into Bahasa Indonesia *"kemasan ramah lingkungan"*.

Students are also unable to specifically mention SDGs related to green to food processing. Most students only answered questions with answers that were not included.

R40 *"Sustainable food"*,

R44 *"Food awareness"*

R47 *"Related to stunting and poverty"*

R65 *"Food Security"*.

R95 *"Act to realize a village without poverty"*,

R105 *"Global wealth"*,

Those answers did not represent the SDGs related to green to food processing which is: (1) Goal Number 2 Zero Hunger, (2) Goal Number 3 (Good Health and Well-being, (3) Goal Number 12 Responsible Consumption and Production, even from the existing 17 Goals of SDGs [17].

Based on our findings, students have a lack of awareness on most of the 8 green technology terms of food processing. The 8 selected green technology terms of food processing current Emerging Practices and Technologies for Greener Food Production [15]. Technological shift that changes job characteristics require employees to learn new skills to do their jobs and learn new skills to compete in different jobs [26]. As part of green skills, low awareness of green technology on food processing of prospective teachers will have a negative impact on the process of knowledge transfer and student competency development, since teachers play an important role in education [18].

Furthermore, TVET teachers are expected to be able to teach green skills, and to increase their students' environmental awareness, in this respect regarding green technology on food processing [19]. Therefore, students of prospective agricultural vocational teachers need to be exposed and educated in the practice of green technology on food processing as part of the curriculum.

C. Student Need Assesment to Learn Green Technology Concepts on Food Processing

The study continued by looking at their needs after being met with 8 green technology terms of food processing. Respondents' self-assessment was whether they felt the need to learn green technology on food processing or not. Respondents responded to statements with a scale of very necessary, quite necessary, moderate, quite necessary, and very unnecessary. Table 2 shows student need assessment to learn green technology concepts on food processing.

TABLE II.   STUDENT NEED ASSESSMENT TO LEARN GREEN
TECHNOLOGY CONCEPTS ON FOOD PROCESSING

Statement	Reported Level of Awareness (%)					Mean (M)	Standard Deviation (SD)
	1 (Verry Unnecessary)	2 (Quite Unnecessary)	3 (Moderate)	4 (Quite Necessary)	5(Very Necessary)		
As a prospective teacher of SMK Agritechnology, I need to learn green technology on food processing	0 (0)	0 (0)	3,74 (4)	78,5 (84)	17,76 (19)	4.7	0.515

In general, students agreed that they need to learn green technology on food processing (n=107, M=4.7, SD= 0.515). Most respondents considered themselves quite necessary to learn green technology on food processing (78.50%), while the rest stated that it was very necessary (17.76%), some answered moderately (3.74%).

Based on our findings, there is a high sense of student need to learn green technology on food processing, although there are a small number of students who answer "moderate". For those who answered "moderate", this shows the situation of students who are not pressured to have to respond according to what is socially expected [20]. Respondents were also suggesting green technology on food processing should be integrate into courses:

R33 *"it looks like food processing technology and its branches such as fruit vegetable processing technology, cereal processing technology, nuts and tubers. Meat processing technology, confectionery processing technology, spice and herbal processing technology, oil and fat processing technology, and starch technology"*,

R49 *"...occupational health and safety course, and pedagogical courses such as agro-industrial technology teaching planning."*

R70 *"...all productive courses."*

R85 *"...all basic courses including basic biology, basic chemistry, and basic physic."*

R99 *"...Every course related to the processing of a material, either animal, vegetable, etc. especially in waste management courses."*

High student desires and professional demands for awareness of green technology on food processing must be facilitated and accommodated through the education system. Thus, green skills must be developed through curriculum development, training, education, learning and teaching [21]. Findings from this open-ended question also revealed that prospective teacher of agricultural vocational school did not think that green technology has been integrated in the learning process yet.

Green Skills focuses on the skills, knowledge and attitudes needed promote economic and social sustainability to enhance environmental development in business and society [19]. Prospective teachers of agricultural vocational school need to be equipped with hard skills and soft skills, in order to develop green practices in the workplace [22]. More than that, prospective teachers must have competence in green skills to educate students [23].

Currently, vocational high school in Indonesia use the 2013 curriculum, which was conceptualized by the Ministry of Education and Culture of the Republic of Indonesia. The existing curriculum does not include green skills explicitly in the current vocational school curriculum [24]. The integration of green technology on food processing into the learning process does not always have to create a new course [25]. Based on Hungerford's literature, green skills, generic concept, and sustainable practices can be injected into various courses [26]. Integration can be as simple as linking learning process with existing environmental issues, current sustainable trends and technologies, and practicing usual practicum by also considering energy, water, and waste used and produced. Green skills as a part of ESD can be integrate into teaching content, pedagogy, and assessment [27]. Thus, this research promotes the importance of green technology on food processing to be integrated into the curriculum of vocational high school teachers' education.

IV. CONCLUSION

Most students of prospective agricultural vocational teachers have lack awareness of the terms and central issues of green technology on food processing, such as life cycle assessment, carbon footprint, non-thermal food processing, waste management hierarchy as well as green technology itself. Students stated that they were most familiar with the term of green packaging. As many as 78.5% of respondents stated the need for prospective agricultural vocational teachers to learn green technology on food processing. This finding implies the importance of green technology on food processing to be integrated into the curriculum of agricultural vocational high school teachers' education.

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