# E-Module Development of Sustainable Coffee Processing to Improve Vocational Students' Green Skills

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**Abstract:** This study aimed to analyze the eligibility of e-module and the effectiveness of their use in improving the green skills of vocational students. This research used development research using the ADDIE model (analysis, design, development, implementation, and evaluation). The components of green skills studied in this study include knowledge of the impact of coffee processing on the environment, waste management, and sustainable coffee processing innovations. Data collection was carried out through validation sheets distributed to validators to determine the feasibility of the e-module. In addition, test questions were used in this study to determine the effectiveness of the e-module in improving students' green skills. Furthermore, the data were analyzed using the N-gain test. The results showed that the E-module was eligible according to material experts, learning media experts, and linguists. In addition, the e-module is quite effective in improving vocational students' green skills. The results of this study indicate that the integration of the concept of sustainable coffee processing into learning media is the right decision for improving the green skills of vocational students

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## Introduction

The business world and the industrial world, including the food industry, are transitioning to a green economy, given the rise of environmental issues in the last decade (Loiseau et al., 2016). The food industry is considered to have contributed to the negative environmental impact because it causes an increase in gas emissions due to energy use during the production, distribution, and waste production processes (Tiwari et al., 2013). The green economy transition requires special skills for prospective employees (Pavlova, 2017). It makes the industry look for prospective employees with green skills to support sustainable social, economic, and environmental development (Kokkinen, 2013). Food industry practitioners agree that green skills are essential and needed by graduates of vocational high schools in food processing agribusiness (Handayani et al., 2020a).

The results of the study indicate the weak competence of green skills of vocational students in food processing agribusiness in West Java on waste management skills as a form of technical mastery, communication skills as a form of interpersonal competence, and innovation skills as a form of intrapersonal competence (Handayani et al., 2020b; Fitriyanto & Pribadi, 2021; Saputri & Ediyono, 2022). It is understandable since the development of green skills has not been mentioned in the Indonesian vocational education curriculum (Setiawan, 2017). In food processing agribusiness, improving green skill competencies is

needed through more practical education and training for vocational students (Asnawi & Djatmiko, 2015).

In the subject of Plantation and Herbal Commodity Processing Production at vocational high school, the basic competence in applying the processing of coffee, cocoa, tea, and tobacco plantation products only contains the content of coffee primary processing material. The coffee processing material only covers coffee beans' production without paying attention to the potential for sustainable coffee processing by processing by-products from coffee processing, one of which is coffee grounds. Based on observation at school, the practicum process is only limited to roasting without further processing. The main learning resource used was the 2013 Curriculum Electronic School Book. The limited material and learning resources make students unable to see the potential for food processing based on the waste management hierarchy as part of green skills. Therefore, it is necessary to have alternative teaching materials that are full of food processing processes based on a waste management hierarchy to hone students' green skills by processing coffee grounds waste, for example.

One form of learning media that can be used as a learning resource and integrated with green skills is the E-module, a learning media designed systematically and attractively, including learning materials, methods, and evaluation systems (Hakim et al., 2020). E-Modules can be combined with interactive multimedia such as animations, videos, practice questions, and interesting evaluations (Sefriani & Wijaya, 2018). The results of that study prove that interactive multimedia modules have an adequate level of 86.90% for learning.

A preliminary study through interviews with teachers at the food processing agribusiness expertise program at the Lembang Agricultural Vocational School, West Java showed that e-modules had been effectively and efficiently used in the learning process. However, its availability is still limited to a few subjects, consequently needing to be developed more, especially those that can improve students' green skills. In addition, e-modules are more flexible to be used by students because they can be accessed anywhere and anytime through their devices without having to install applications that take up storage space on their devices.

One kind of E-module developed as a learning medium is PDF Interactive (Portable Document Format). It allows creators to add particular objects that can change appearance when touched (Seruni et al., 2019). The shortage of this type is that the printed version cannot be optimally used. Therefore, it needs to be integrated with QR code technology to contain information that can be accessed even in printed form (two-dimensional) to increase user flexibility in utilizing the module both digitally and in print (Mustakim et al., 2013). This study aimed to analyze the eligibility of e-module and their effectiveness in improving vocational students' green skills.

**Research Method**

This research used development research using the ADDIE model (analysis, design, development, implementation, and evaluation) developed by Dick and Carry (2001). This model was appropriate because it was systematic and complete, consisting of five steps to ensure the results are in accordance with the desired goals and make the learning process more effective (Alwi & Thursday, 2019). Modules developed using the ADDIE model have similarities with other module developments and are behaviorism-based to plan an effective learning system. This model describes a systematic approach to the development of learning systems (Molenda, 2015) which are considered sequential and repetitive (Figure 1).
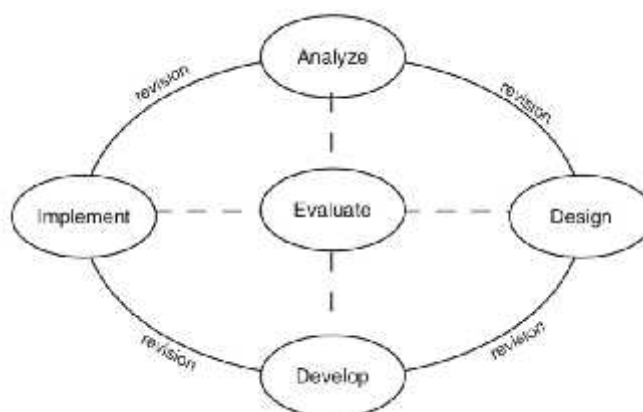
**Figure 1. ADDIE model (Branch, 2009)**

The ADDIE model is a very effective tool for developing educational products and learning resources (Branch, 2009). The application of ADDIE can build performance-based learning where the applied learning must be student-centered and innovative, authentic, and inspiring. This model (Fig. 1) describes the process applied to design the development of e-modules as teaching materials to be used in learning coffee processing technology in SMKs. The stages of this model are compatible with module development, starting with needs analysis and ending with module evaluation. According to Alwi & Kamis (2019), this is relevant because it facilitates the design process, where the results of each stage become evaluation material for the next stage.

The first stage of the ADDIE model is analysis. In this stage, researchers identified and analyze various things used as the basis for designing and developing products. Analysis of problems and potentials was also carried out to determine the main problems that occur in learning and observe the students' condition at school. Learning materials were analyzed to determine the need for materials that are in accordance with research objectives and become the basis for determining relevant learning materials. Product analysis was carried out to find out what features are needed based on the conditions and needs of students.

In the design stage, as the second stage, a concept or product design was designed from the analysis results in the previous stage, along with related instruments. Flowcharts help design the navigation structure from one view to the next to clarify the design of making learning media. The e-module material's drafting contains the material's scope, and indicators of competency achievement following the curriculum and lists the content of sustainable coffee processing according to the green skills component. The research instrument used was a validation sheet of media, material, language experts, and student response questionnaires.

In the third development stage, an e-module learning media product was developed in the kind of an Interactive PDF based on the design that has been made. The e-module development process uses the Microsoft Word 2019 application as an e-module preparation application and the support of CorelDraw X7 as a graphics application to support the e-module aesthetic. The e-module features that will be developed include video navigation buttons, QR Code, and graphics in the form of images and text. The QR Code feature was developed using the QR Code Generator.

The e-module, which had been improved based on the validator's suggestion in the previous stage, was tested on students in the fourth stage, the implementation stage, to obtain feedback from students on the digital learning media that had been developed. The evaluation stage is the final stage of the ADDIE model, with an evaluation process for the modules being developed. This stage is based on module trials conducted by the validator and module feasibility assessments through questionnaires. The evaluation phase can occur at the four

previous formative evaluation stages. Based on these stages, the modules developed are revised to be widely used as learning media for sustainable coffee processing technology.

This research involved various experts as validators of the developed e-module, as well as vocational high school (SMK) students as respondents to the feasibility and implementation test of the e-module. The population in this research were students at food processing vocational high schools in Lembang, West Java. The sampling technique used in this study was purposive. There were 41 students of class XI involved in this study. Data collection was carried out through validation sheets distributed to validators to determine the feasibility of the e-module. In addition, test questions were used in this study to determine the effectiveness of the e-module in improving students' green skills. Furthermore, the data obtained were analyzed using the N-gain test.

**Results and Discussion**

E-modules were developed based on flow charts and storyboards designed at the design stage. The flow of the development process can be seen in Figure 2. The development process began with making systematic arrangements for writing and compiling the layout using the Microsoft Word application. The settings were to define a new multilevel list, margin, styles, table of contents, paragraph, header and footer, and paper size. The arrangement was intended to facilitate writing and transferring material into e-modules. All learning materials were included in a word document called a draft e-module.

Microsoft Word was chosen because of its ease of operation. In addition, Microsoft Word is a word-processing application that various groups of people in Indonesia, including teachers, commonly use. Ikhwani et al. (2015) stated that Microsoft Word is a reliable word-processing application and is most widely used by computer users. Microsoft Word is appropriate for a module maker because it allows users to combine words and graphic features such as images and statistics into one document (Purnomo, 2011). However, its easy and limited use can be a drawback for creating more complex modules. So, Microsoft Word is only used as the main collecting document. Therefore, other applications were needed to complement the quality and creation of e-module development, such as graphic applications and interactive features.
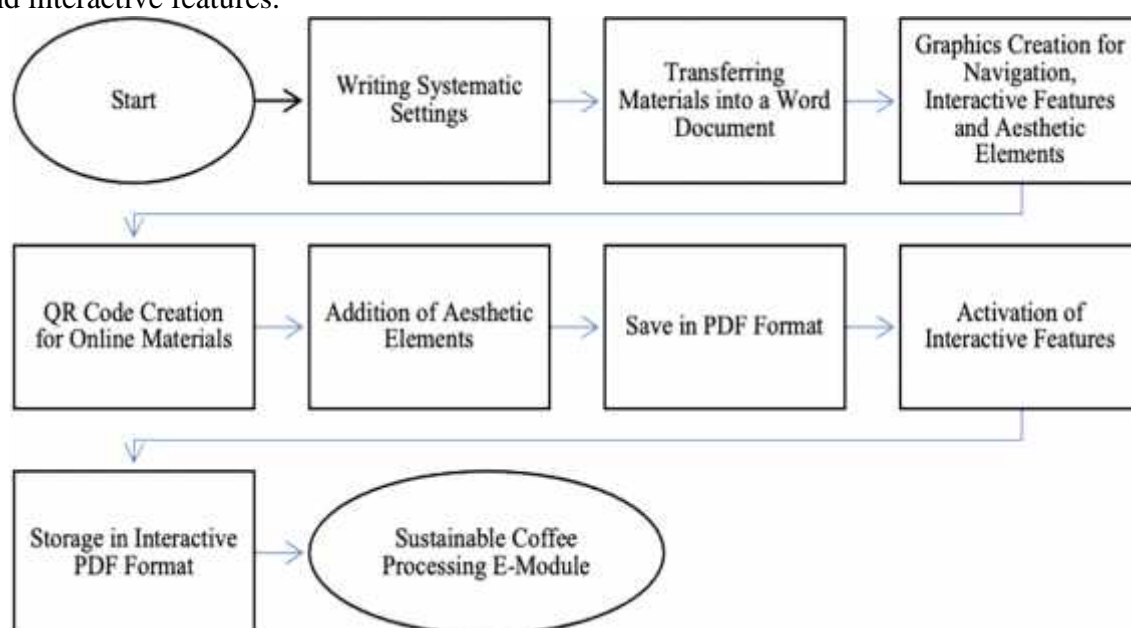


**Figure 2. Flow Chart of E-Module Development**

Drafts were equipped with visualizations in the form of images and navigation buttons. Simple image visualization obtained from iStock.com web and Google image search. While complex visualizations that must be made independently, such as navigation button designs, infographics, concept maps, flowcharts, covers, and other aesthetic elements, are done using the CorelDraw X7 graphics processing application.

The CorelDraw application is a professional graphics processor with full features that makes it easy for users to create graphic visualizations (Yanto et al., 2022). Because of the complexity of the features that can be arranged, the general public does not commonly use this application; therefore, this application is only used by professionals and competent users. Another alternative application that can be used is Canva. Using Canva is more straightforward and accessible since it provides many design options and templates (Leryan et al., 2018). Canva can make it easier and save teachers time designing learning media (Hapsari & Zulherman, 2021). Adding graphics is essential to increase students' interest in learning. It follows the statement of Triyono (2021) that adding graphics such as images and other visual media can make e-modules more attractive.

To make the e-module more interesting, multimedia features such as learning videos and downloading additional documents were added. The video feature was added by copying the video URL on the internet into a clickable link in the e-module. Videos are selected from credible YouTube channels belonging to official institutions, while additional documents are selected from reliable document sources. All multimedia features can only be used on the digital version of the e-module. The author added a QR Code feature to increase access to e-modules in printed form. QR Code allows users to connect digital resources to printed text (Mustakim et al., 2013). Using QR Codes can enrich paper-based learning materials to meet student learning needs (Chen et al., 2010). QR Code can be scanned using a smartphone to access the content. This is supported by the research of Nurhidayah et al. (2021) that the QR Code developed in the learning process is considered adequate. QR Code creation was done online via the web https://id.qr-code-generator.com/. Content links in the form of URLs can be converted via a web QR Code.

All images and aesthetic elements were added to the draft for further saving in a draft PDF format. The draft added interactive sections such as video links, fields to fill out answers directly, options to choose from, and other navigation features. The interactive PDF draft feature was activated through the https://pdfescape.com/ web page. PDFescape is a free online PDF reader application capable of creating interactive form features that can be filled out or touched directly in a PDF document (Cohn, 2021). The downloaded PDF was from now on referred to as the Interactive PDF. This PDF was named Sustainable Coffee Processing E-Modul.pdf (PDF extension). The E-Module was then validated by experts, as shown in Table 1.

**Table 1. Validation of Module by Experts**

| No | Aspect | Score | Criterion |
|----|--------|-------|-----------|
| | **Material experts** | | |
| 1 | Relevance of the module to the curriculum | 3,67 | Very eligible |
| 2 | Module material accuracy (concepts, definitions, terms, data presentation, facts, pictures, diagrams and illustrations) | 3,73 | Very eligible |
| 3 | Student encouragement | 3,89 | Very eligible |
| | **Learning media experts** | | |
| 1 | Appearance of learning module (color composition, layout, illustration, design) | 4 | Very eligible |
| 2 | Perceived ease of use (coherent presentation, easy to operate, | 3,33 | Very eligible |

| No | Aspect | Score | Criterion |
|---|---|---|---|
| | clear instructions for use, navigation buttons and QR code work well, | | |
| 3 | Consistency (the use of words, terms, shapes and letters, arrangement of layout) | 3 | Eligible |
| 4 | Usability (make it easier for learning) | 3 | Eligible |
| 5 | Graphics (use of color, image illustrations, video narration, font size and type) | 3,71 | Very eligible |
| 6 | Completeness of learning module components | 3,58 | Very eliglible |
| | **Linguist validation** | | |
| 1 | The accuracy of the sentence structure and the effectiveness of the use of sentences | 4 | Very eliglible |
| 2 | Communicative (accuracy of terms, easy to understand) | 3 | Eligible |
| 3 | Dialogic & interactive (motivate & encourage students) | 3 | Eligible |
| 3 | Suitability to student's development | 3 | Eligible |
| 4 | Conformity with linguistic rules | 3 | Eligible |
| 5 | Use of terms, symbols and icons | 3 | Eligible |

## *Material Experts Validation*

Aspects of the validated e-module material are the suitability of the material with the learning objectives, the accuracy of the material, and encouraging student curiosity. It is under the regulations of the National Education Standards Agency (2017) that the eligibility aspect of the material must follow the learning objectives, the accuracy of the material, no differences in interpretation, and be supported by appropriate learning materials. The accuracy of the material is a synchronization between the objectives, content, and evaluation of the learning material (Musfiqon, 2012). Learning materials must also be adequately delivered to increase students' interest in learning and understanding (Varma & Linn, 2012).

The relevance aspect of the material in the module with the curriculum is categorized as "very eligible" (Table 1). These aspects relate to the completeness in conveying the material, the flexibility in elaborating the material, and the depth presented. Learning materials are developed based on learning objectives that have been adjusted referring to the 2018 regulation of the directorate general of primary and secondary education of the Indonesian Ministry of Education and Culture (Perdirjen Dikdasmen No.464/D.D5/KR/2018) without reducing the essence of the existing subject matter. The position of the material has a significant meaning in helping individual learning by providing completeness, flexibility, and depth of learning material. The main principle in preparing teaching materials is the relevance and synchronization of objectives, content, and evaluation of learning materials (Musfiqon, 2012).

The accuracy aspect of the material in the e-module is categorized as "Very Eligible" (Table 1). The accuracy of the material includes concepts, facts, data, case examples, illustration images, and terms used. Although it is considered very feasible, several terms and illustrations need to be revised according to the advice of material experts. The material must be prepared accurately to avoid students' misconceptions (Firdaus, 2014). Based on table 1, it is known that according to experts, e-modules can encourage students' curiosity, with the results of the validation being categorized as "Very Eligible." This aspect is related to the external motivation of students to increase curiosity, learning motivation, and ability to ask questions. The e-module is prepared with apperception and motivation in each sub-chapter to

provide curiosity and motivation to study the sub-chapter. Learning media must have benefits and attract students' attention so that it can cause learning motivation (Sanaky, 2013).

The results of the material expert validation show the eligibility of the e-module and can be applied with revisions in several parts. Suggestions given by experts related to the material included a deeper explanation of the concept of waste treatment, adding explanations for various variations of postharvest processing, adjusting images/illustrations according to the topic, writing consistency, and adding QR Code features to additional downloadable materials.

### *Learnig Media Experts Validation*

The validated aspects of the e-module media consisted of appearance, perceived ease of use, consistency, usability, graphics, and completeness. The assessment indicators refer to the guidelines for Education and Culture (2017) and Erinawati (2016); e-modules are interactive learning media equipped with video, animation, and audio presentations to enrich the learning experience.

The appearance aspect of this sustainable coffee processing e-module was categorized as "very eligible." This aspect related to a color composition, layout, graphic illustration, title clarity, and aesthetic appeal. One of the advantages of this e-module was the large number of graphic illustrations arranged according to the context of the material being discussed. In addition, there are uniform color combinations according to the nuances of the image displayed. It gives the developed e-module a stunning impression from the appearance aspect. Learning media must have readability, ease of use, display quality, and program management quality (Arsyad, 2015).

The perceived ease of use of the sustainable coffee processing e-module is categorized as "very eligible." This aspect is essential because the module must have user-friendly criteria; every instruction and information exposure that appears must help and facilitate the user, including the ease of responding and accessing the module as desired. The aspect of consistency in the sustainable coffee processing e-module is categorized as "eligible." This aspect relates to the consistency of terms, letters, and layouts. Although it has received a proper predicate, several paragraphs have unequal font sizes, so improvements and detailed studies are made to correct inconsistencies in writing. Consistency in fonts, spacing, and layout is an essential aspect of preparing e-modules because the perceived benefits and perceived ease of use have a positive influence (Nassuora, 2013).

The graphic aspect of the sustainable coffee processing e-module is categorized as "very eligible." This aspect includes using color, font size, typeface, image illustrations, video player, and video quality. Color selection is made by maximizing white and other supporting colors in moderation to maintain the readability of the material. Using and selecting colors in learning media can help understand concepts by users (Tri, 2011). The font size and typeface chosen is Calibri Body with size 12, where typographically, Calibri has clean and straightforward characters, so it is very appropriate for professional reading text types (Alisjahbana & Achmad, 2014). The image illustration is made into an infographic to take the time needed to interpret the information effectively. Infographics have the advantage of being easy to remember (Miftah et al., 2016). This e-module added an enrichment video linked to YouTube, a relevant open-source video. YouTube is considered adequate as a learning medium in the form of audiovisual (Indriyanti, 2021).

Aspects of the completeness of the sustainable coffee processing e-module are categorized as "eligible." However, several indicators are categorized as "not eligible" because there is no glossary, motivational and apperception sentences, and attachments. The

glossary is essential in an article to help readers understand the definition or explanation of difficult words and align the perception of the terms intended by the author (Gunawan et al., 2017). Sentences of motivation and apperception must arouse attention and motivate students to what will be learned to increase curiosity (Satria & Kusumah, 2019). Therefore, the e-module was revised by adding a glossary, motivational sentences, and attachments using the download feature of additional documents such as SNI. Overall, the media expert's assessment of this e-module is very eligible.

### Linguist Validation

The validated aspects of e-module language are accuracy, communication, dialogical and interactive, suitability to student's development, conformity with linguistic rules, and using terms, symbols, and icons. Aspects and validation indicators refer to the Basic and Secondary Education Lesson Text Assessment Guide (BSNP, 2017). The accuracy aspect of the sustainable coffee processing e-module is categorized as "very eligible." This aspect included the structure's accuracy, the sentence's effectiveness, and the term's standard. However, some terms, such as "penggerbusan" and "kontinyu," are not standardized and inaccurate. Therefore, the terms were replaced with "perendaman" and "berkelanjutan." The simplicity of the language is essential where the language used must be arranged clearly and efficiently, and the selection of the right words can reduce the occurrence of changes in concepts and information gaps (Yuniarti et al., 2012).

The dialogical and interactive aspects of the e-module are categorized as "eligible." This aspect includs motivational sentences and apperception for readers. Learning media is said to be dialogical and interactive if the writing style contains the structure of commands, questions, and invitations that color the learning media (Rahmawati et al., 2016). Therefore, in the e-module, an invitation sentence was added at each turn of the learning sub-chapter. Dialogic and interactive aspects are related to the interaction and communication between learning media and students (Rahmawati et al., 2016).

The aspect of suitability to a student's development is categorized as "eligible." This aspect relates to intellectual and emotional suitability. The preparation of the e-module uses informal language but still pays attention to good and correct language rules. Material writing is also carried out by paying attention to students' intellectual and emotional development using simple and easy-to-understand language. E-modules must be prepared in a language appropriate to students' knowledge and age so they can learn independently (Prastowo, 2015).

The aspect of conformity with the linguistic rules of the e-module is categorized as "not eligible". This aspect relates to grammatical accuracy and correct spelling used. Unlike the correct spelling in this module, it is found in using the word "di" for adverbs and verbs. In addition, several scientific nomenclatures were found that were not italicized. Therefore, the error was corrected. The use of language following the rules of Bahasa Indonesia is essential to maintain the perfection of meaning and avoid misperceptions and misconceptions of readers (Moeliono et al., 2017). Aspects of using terms, symbols, and icons of e-modules are categorized as "eligible." The consistency of terms, symbols, and icons is essential to language (Nugroho & Rusdiana, 2022). Overall, the results of the linguist's assessment are eligible.

### Effectiveness of using e-module

Increasing students' knowledge of green skills was measured using a quasi-experimental method, where the control and experimental classes received the same pretest and posttest questions but with different treatments. In this study, the control group was given

a learning module commonly used by schools, while the experimental group was given an e-module on sustainable coffee processing. The grid of questions provided includes components and indicators of green skills in sustainable coffee processing (Table 2).

**Table 2. Grid of Questions**

| No | Green Skills Component | Green Skills Indicator | Material |
|---|---|---|---|
| 1 | Knowledge of the impact of coffee processing on the environment | Understanding coffee and its waste | Knowing coffee bean |
| | | Determining the impact of coffee processing on the environment | Sustainable coffee processing |
| 2 | Knowledge of waste management | Understand the concept of waste management hierarchy | Sustainable coffee processing |
| | | Define sustainable coffee processing | Sustainable coffee processing Potential Coffee By-Products |
| 3 | Knowledge of sustainable coffee processing innovation | Determining the potential waste from coffee processing | Potential Coffee By-Products |
| | | Determine the use of coffee waste into value-added products | |

The research results showed differences in learning outcomes between the experimental and control groups. The N-Gain Test was then carried out to compare the difference in the increase in the average value of learning outcomes between the experimental group and the control group (Table 3).

**Tabel 3. N-gain Test Results**

| | N-Gain (%) | |
|---|---|---|
| | Experimental Group | Control group |
| Minimum | -50,00 | -20,83 |
| Maksimum | 64,71 | 43,75 |
| **Average** | **33.50** | **18.31** |

Table 3 shows that the average value of N-Gain for the experimental group is 33.50% or has a moderate level of effectiveness. Meanwhile, the average value of N-Gain for the control group is 18.31% or has a low level of effectiveness. Using sustainable coffee processing e-modules effectively improves student learning outcomes, namely students' knowledge of green skills. The components of green skills studied in this study included knowledge of the impact of coffee processing on the environment, waste management, and sustainable coffee processing innovations. E-module can improve students' understanding of the concept of learning. Students who use interactive e-modules have higher learning outcomes than conventional modules (Wulandari et al., 2020).

In this study, an increase in student learning outcomes can be associated with an increase in knowledge of the green skills component of students. The experimental group using the sustainable coffee processing e-module had a higher N-Gain percentage in all components of green skills than the control group. It shows an influence between the module infused with the concept of sustainable coffee processing and the knowledge of students' green skills. The knowledge component regarding the impact of coffee processing on the environment contains the subject matter of knowing coffee cherries (red cherry) which

explains the morphology of coffee. In addition, the principles of sustainable coffee processing are also explained, including the wet method, dry method, and coffee quality standards. Based on increased knowledge about the impact of coffee processing on the environment, both groups experienced increased knowledge. The experimental group had a higher increase than the control group. The difference in improvement between the two groups was 1.34%. Although the difference is insignificant, integrating continuous coffee material into the learning material makes a difference in students' learning outcomes.

Knowledge of the impact of coffee processing on the environment is considered necessary; this follows the opinion of Ozden (2008), which states that students in developing countries need education to increase their sensitivity to environmental problems and help them solve them. Schools must develop curricula and subjects related to practical knowledge that impacts the environment (Özden, 2008). The higher a person's knowledge about environmental problems, the more environmentally friendly behavior will be reflected (Mei et al., 2016).

The knowledge component of waste management contains indicators for determining sustainable coffee processing and analyzing the quality control of the coffee processing process. The integrated materials include the potential of coffee by-products and their nutritional content that can be further utilized. In addition, the concept of a general food waste management hierarchy was introduced. Based on the increase in knowledge regarding waste management knowledge, the experimental group had a higher increase than the control group. Integrating sustainable coffee materials into learning materials makes a difference in student learning outcomes. It is essential to integrate materials related to waste management knowledge. Students of the vocational school of Food Processing Agribusiness must understand waste management in the food industry to support the development of a green industry (Handayani et al., 2020a). Food waste is believed to contribute significantly to the increase in greenhouse gas emissions (Tiwari et al., 2013). Food industry practitioners need workers with the knowledge and ability to manage and treat waste (Handayani et al., 2020a). The vocational schools must be able to prepare students to work in the business world and the industrial world, in this case, the food processing industry (Subijanto & Sumantri, 2020).

The last component of green skills is knowledge about sustainable coffee processing innovations. This component contains indicators determining the utilization of coffee by-products. The material tested was the knowledge of students on the use of coffee by-products accompanied by scientific reasons. In addition, the concept of a general food waste management hierarchy was introduced. The experimental group had a much higher increase than the control group. It is presumably due to adding specific material on coffee by-products accompanied by a scientific video. This difference in learning outcomes is fundamental to the ability of students to explain the proposed coffee waste treatment innovation with scientific reasons. The control group proved unable to explain the proposed innovation scientifically.

Based on the needs of industrial practitioners, innovation knowledge is a component of green skills that prospective students must possess to work in the food industry, in this case, the Food Processing Agribusiness Vocational School (Handayani et al., 2020b). Increasing innovation knowledge is essential in supporting reform in an economy where many jobs require innovation (Toner, 2011). Innovation knowledge is needed to seize opportunities and develop strategies to respond to environmental problems (Pavlova, 2017). From the perspective of vocational schools, students must be able to capture food development innovation opportunities in various food processing processes.

Based on the improvement of students' green skills in knowledge, the sustainable coffee processing e-module can be an example of the infusion of green skills into the

curriculum. Education is the best way to instill green skills in students to produce competent human resources and maintain environmental balance (Thirupathy & Mustapha, 2020). Therefore, integrating sustainable coffee processing into learning media is the right decision to improve the green skills of vocational students.

## Conclusion

The results of this study conclude that the sustainable coffee processing e-module was eligible based on the assessment of material experts, media experts, and linguists. The use of E-modules was quite effective in increasing the knowledge of green skills of food processing Agribusiness Vocational High School students. The green skill components tested include knowledge of the impact of coffee processing on the environment, knowledge of waste management, and knowledge of sustainable coffee processing innovations.

## Recommendation

The results of this study can be utilized by vocational high school teachers in their classroom learning. They must also develop the e-module to complement the material content and other subjects. Vocational school leaders, as policymakers, need to facilitate the development of this type of e-module to improve students' green skills.

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