Name	Counter-part	Title
I Nengah Suparta, Luh Mitha Priyanka, I Wayan Muderawan	**PR**	Developing Socio-Scientific Module Based on the Pros and Cons of Using Pesticides in *Citrus Nobilis* Cultivation for Enhancing Student's Awareness and Participation

Background and Objectives

The teaching materials used in an environmental science course still lack the use of contextual issues. It turns out that some students have difficulty in learning due to an unrelated problem. According to Manuel (2014), one of the best instructional materials to stimulate the learning experience is a module. A module is defined as a self-contained, independent unit of a planned series of learning activities, designed to help student achieve specific, well-defined goals. This module is based on socio-scientific issues, especially in environmental issues terms. Module-based on socio-scientific issues is expected to increase student's understanding of some common issues in their surroundings. This module is also designed to align with the educational approach of the *EFForTS* PR project by addressing a local problem in the *Citrus nobilis* cultivation to raise awareness in preventing agricultural land (*Citrus nobilis* landscape) from the negative effects of using pesticides. This issue is relevant to the *EFForTS* project in terms of ecological and socioeconomic.

Methods

Instructional design is a process that involves the creation or adaptation of instruction. Most research evidence concerning instructional theories relies on fundamental principles that address and respond to learning needs and goals). The basic goal is to identify conditions of instruction that optimize learning, retention and transfer of learning. The starting point is to consider an already useful approach to course design: Analysis, Design, Development, Implementation, and Evaluation (ADDIE) model (Fig. 1).

Figure 1. ADDIE Model

Results and Conclusion

Module based on socio-scientific issue in Citrus nobilis cultivation in Kintamani was develop using this following stage.

Analyze Stage

The first stage was conducted by analyzing several things such as literature review, needs assessment, and student analysis.

Design Stage

The second stage of this developmental model is the design stage, in which the results of the analysis stage are used to plan a strategy for the development of a module with socio-scientific issues that align with the educational approach of the *EFForTS* PR project. The module is divided into four sections, mainly addressing the problematic issues in *Citrus nobilis* cultivation in Kintamani, Bali, based on a teaching model using SSI-TL. Using socio-scientific teaching and learning, the first section begins with identification of focus topics. Here, students learn about some ecological and socio-economic impact of *Citrus nobilis* cultivation. Students then learn about SWOT analysis in the use of chemicals in *Citrus nobilis* cultivation. In the second section, this module help students engage in three-dimensional learning related to *Citrus nobilis* cultivation. They will discover disciplinary core ideas, crosscutting concepts, and scientific practice in these socio-scientific issues. Then, students will learn to identify a possible pathway as the best

solution related to using pesticide in *Citrus nobilis* cultivation issue (including evaluation and reflection) through *Citrus nobilis* Organic-Farm Management. The last section introduces the concept of sustainable development and discusses how *Citrus nobilis* Organic Farm Management relates to it. In every section, the module is completed with the learning objective, some information related to the issue, summary, and an evaluation. Figure 2 shows the cover design of this module using a citrus 'picture' from the farm.

Figure 2. Design of SSI-TL Module

Based on the interview, using pesticides two to three times per month has negative impact. Pesticide residues and their persistence on or in food are an important and well-known concern for human health and environmental safety. When a pesticide is applied, it reaches not only the target but also other organisms in the ecosystem. Pesticides promise the effective mitigation of harmful bugs, but unfortunately, the risks associated with their use have surpassed their beneficial effects. Non-selective pesticides kill non-target plants and animals along with the targeted ones. In addition, some pests develop genetic resistance to pesticides over time. Because of the negative impact, pesticide residue analysis in citrus and soil is important to know how dangerous the pesticides are. The method used to analyze the residues in citrus and soil is extraction. Figures 3 and 4 showed the process of pesticides residue analysis and the result.

Figure 3. Extraction of Pesticides Residue

The analysis showed that pesticide residues in citrus and soil are quite high. The pesticides residue in citrus peel are 2–3 ppm. Meanwhile the residue in soil is also around 1–2 ppm. This fact gives some impact on the environment. The result of this analysis will be presented in the module to provide information on how dangerous the residue of pesticides to the environment and human health. Students are expected to find out a solution for this situation.

Citrus nobilis organic farm management is one of the solutions shown in the module to overcome the issue. Modern organic farming was developed in response to the environmental harm caused by the use of chemical pesticides and synthetic fertilizers in conventional agriculture, and organic farming has numerous ecological advantages. Compared to conventional agriculture, organic farming uses organic fertilizer, biological control and fewer pesticides, reduces soil erosion, decreases nitrate leaching into groundwater and surface water, and recycles animal wastes back into the farm. With the help of this module, students will learn about Citrus nobilis organic farm management and how far this method relates to sustainable development.

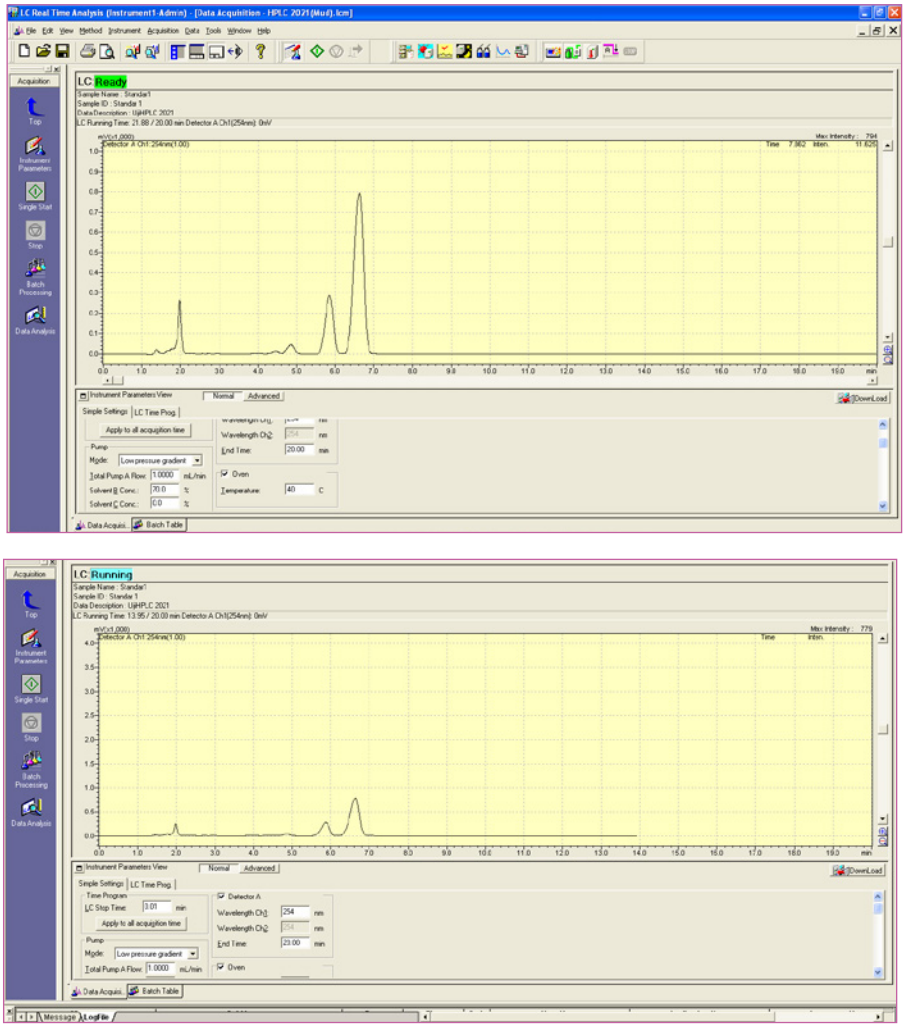

Figure 4. The Result of Pesticides Residue in Citrus and Soil

Development Stage

Socio-scientific module on the advantages and disadvantages of using pesticides in Citrus nobilis cultivation, which has already been developed, needs to be reviewed by a panel of expert. The judges will review the module based on the design, content, and also language. This module (prototype 1) will be tested by three expert judges from physic, biology, and chemistry education department.

Some feedback from expert lecturers will be revised to become prototype 2. Some scientific data, photo and illustration will be attached in the module to prove that this issue occurs in Bali. In prototype 2, a questionnaire will be used as a non-test method, the expert will evaluate this prototype again to prepare the SSI module for implementation in the next semester. The result of second evaluation by three expert lecturers can be seen in the table 1 below.

Table 1. Validation Score from Expert Lecturers

Expert Lecturers	Score	Category
1	84.6	Good
2	92.3	Very Good
3	76.9	Good

The average score of prototype 2 from three expert lecturers is 84.6, which is in the "good" category. In the second evaluation, expert lecturers also give some feedback on the language and design of the SSI module for better improvement. In the development stage, after the feedback from the expert lecturers, this module is reviewed by 24 selected students as they will use this module in the next semester. The average score of the 24 students for the SSI module is 89.5 which falls into the "very good" category (Fig. 5).

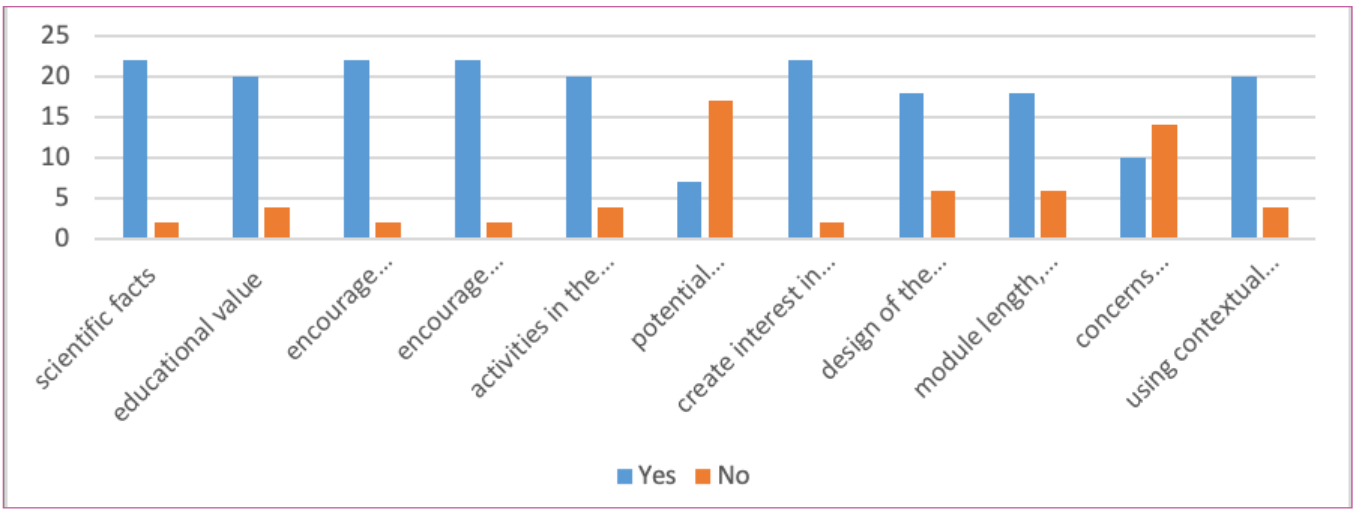

Figure 5. Evaluation by Students

The results of prototype 2 evaluation by expert lecturers and selected students shown that the SSI module which developed is suitable for use and ready to be implemented next semester.
The socio-scientific module is still in the developmental stage for some refinement and make it the final product. This module will be implemented next semester to help students become more engaged with the socio scientific issue surrounding them. By learning using contextual issue, students learn through experience rather than memorization. Contextual learning can encourage students to have a more positive attitude toward science learning. When students can relate the concepts, they have learned to real-life situations, it means that they have inserted the context they have learned into the actual situation and transformed it as life experiences.