Evaluating the integration of research-based internship with sustainable environmental thinking

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Abstract. The integration of theory and practice in the learning process has become the foundation of architectural education. In learning a sustainable environment, direct involvement of students in the environment to increase awareness of sustainable development is fundamental. Internship is a learning process where students can develop themselves outside of lecture hours. The impact of the COVID-19 storm demanded new education methods in the learning process. The architecture study program of the Sumatra Institute of Technology (ITERA) has started an internship on a research project for the past 1 year. This paper aims to investigate the extent of students' awareness in terms of environment sustainability while they undertake the research-based internship. While the research objectives are: to examine the attitude of students in delivering sustainable thinking; to investigate the sustainability knowledge that obtained by the students during the internship, and to acknowledge the student skills regarding environment sustainability thinking. This exploratory research uses content analysis method and conduct an online survey from students involved in the internship. It is concluded that the internship through research project improve social skills, context analysis and environmental awareness, but there is a need for improvement in the delivery of lectures related to real strategies and implementation in realizing environmental sustainability.

1. Introduction

As part of the contribution of the Institut Teknologi Sumatera (ITERA) towards the achievement of Sustainable Development Goals (SDGs) 2030, ITERA officially has a SDGs Centre which one of the mission is to provide education, assistance, and implementation cooperation [1]. In the smallest realm, it is reflected by the learning process with various methods. In addition to reinforce the Masterplan for the Acceleration and Expansion of Indonesian Economic Development (MP3EI) through human resources development and optimization, the focus of ITERA is to develop Sumatera and nationally accredited. In that context, ITERA was established based on the Presidential Regulation No.124 of 2014 as one of the aims is to respond the backlog of Higher Education Engineering in Indonesia.

Not only the matter of demand, but also it is to prepare and ensure the students can be accepted in the future work environment by providing pioneer study programs. The evidence of that commitment...
can be seen by the new study program, i.e., cosmetic engineering, railway engineering, forest engineering and research centres. The environmentally sustainable way of thinking has constantly become the foundation of ITERA in conducting research, community service, and education which is listed in ITERA Strategic Plan 2019-2024 [2]. Thus, it is no wonder that in the first year of education, there is a course called Sumatran Environment which emphasizes the introduction of the Sumatran region as well as exploring ways of thinking about the root causes of environmental problems around Sumatra.

One of the learning concepts that has been taught by many architecture schools is sustainability, in which there are three main pillars, economic, environmental, and social. However, a research conducted by Filho et al in 7 countries across Europe shows that the concept of sustainable development education has not been integrated into universities [3]. They suggested that one way to increase awareness of sustainable development is to integrate with research topics and environmental assistance to improve sustainability learning [3]. Trebilcock, a professor in Sustainable Architecture has formulated a model to integrate environmental sustainability in architectural education that has three fundamental aspects, i.e., develop attitudes, knowledge, and skills [4]. The view seen by Trebilcock emphasizes that the concept of sustainability will not be maximally absorbed by students without a decent and responsible attitude, explicit knowledge, tacit knowledge as well as intuitive skills, analytical and social dimensions as shown below:

| Attitudes     | Explicit Knowledge                                      | Tacit Knowledge               | Skills                          |
|--------------|---------------------------------------------------------|-------------------------------|--------------------------------|
| Environmental ethics | Principles and strategies of environmentally sustainable design | Critical appraisal of case studies | Design integration           |
| Analytical attitude | Architectural sciences                                  | Quantitative analysis of case studies and the students’ design projects | Use of analytical tools       |
| Social engagement | Scientific and technical language                      | Analysis of sociocultural context | Interdisciplinary teamwork, Effective communication |

**Figure 1.** Trebilcock model: A model for sustainable learning course in architecture education [4].

In more detail, Trebilcock explained that attitude in an architectural practice is very important because of the role that architects have, namely as an agent of change in sustainable design. In addition to off-campus activities, the topic of sustainability will be better understood by interacting with the community, seeing local materials, climatic conditions, natural resources, and living culture. Furthermore, the explicit knowledge aspect is generally found in the curriculum and teaches strategies and principles of sustainable design, so that it can be seen from students’ understanding of the climatic context and building typology. Furthermore, the aspect of tacit knowledge is found in critical and analytical thinking so that it raises the habit and intuition of designing with environmental sensitivity and explore the possibilities that can occur on the land/location. The fourth aspect, namely skills, emphasizes the ability of students to use analytical tools, both physical tools and software, to test building performance which should be obtained by students in learning in class [4].

From the model above, it can be concluded that the integration of learning on the topic of sustainability does not only rely on the delivery of knowledge which there are 4 aspects that support it holistically. Architecture learning tends to be considered successful if the design studio value is good, even though it is rare for a design studio course to involve a community or professional perspective in ITERA. This is a concern because when they get into a work they will be dealing with real clients and will be faced with many conflicts of interest that often sacrifice the environment. In this realm,
Internships can reflect the extent of understanding, absorption and independence of design decision making.

1.1. An overview of internship in ITERA

Internships in the constellation of ITERA curriculum are mandatory courses that must be met as one of the graduation requirements as stated in the curriculum book for Infrastructure and Regional Technology Department [5]. In the architecture study program, internships weigh 3 credits with the aim that students can identify actual problems in the field, analyze, find solutions to problems, and apply the knowledge gained in the ITERA Architecture Study Program. In addition, students are also expected to be able to carry out practical work activities that foster soft skills (the ability to relate to other people, time managerial abilities and self-management) in the practical workplace. From the description above, it can be concluded that internships are expected to be carried out in the company as a provision to introduce the work environment.

It is widely accepted that the internship is one of the phases in architecture education which combines knowledge, skills and attitudes to obtain work experience as found in Indonesia Qualification Framework (IQF) [6]. Internship is intended to be part of off-campus learning and is a form of implementing, confirming the knowledge that has been acquired in the classroom, which is in the internship process, students are expected to learn directly on real cases in certain project scopes [7]. According to Gunders, internship is one of the solutions in keeping up with the development needs of graduates' competence amid a passive learning environment [8].

Relating to the condition of COVID-19, it demands a rapid and huge transformation in all aspect of life, including education. The conventional way that seemingly could not follow the pace of changes forced the education to adapt with new normal system. In the context of architecture education which design studio is the core of curriculum, it is inseparable with the adjustment. Spending ample time in studio room should be avoided, the same goes for internship. When the COVID-19 initially hit the world, most of the company/industry also reduce their project and affect number of students that could not get a chance to do the internship in company. On the other hand, it is almost impossible for the student to extend their study time and spend more money to wait the COVID-19 disappears. Therefore, Architecture program in ITERA initiated to provide an internship opportunity in the research project.

This paper aims to investigate the extent of students' awareness in terms of environment sustainability while they undertake the research-based internship. To be more specific, the internship that become the object of this study is a research-based internship, where students become research assistants as well as solve the issue/ existing problem. So, referring to integrated architectural education, how far is knowledge about environmental and social sustainability implemented and improved in their research-based internships process? To conduct the research, the objectives of this study are: (1) to examine the attitude of students in delivering sustainable thinking; (2) to investigate the sustainability knowledge that obtained by the students during the internship, and (3) to acknowledge the student skills regarding environment sustainability thinking. Those objectives would be undertaken through online questionnaire and analyzed thematically with content analysis which is explained in more detail in the following chapter.

2. Methods

To examine the extent of environmental sustainability knowledge that is being implemented in architecture education particularly internships, an online survey was conducted with the target respondents are the students who took or still conduct research-based internships after the emergence of COVID-19 in architecture study program. Internships are part of evaluating students' readiness to face the work environment, which combines knowledge, skills, and attitudes/work ethics. Internships are intended to measure the absorption of knowledge that has been explored in class and put it into practice in front of a mentor/coach. In this matter, the theories that have been learnt, awareness and
application of environmental sustainability is one of the important points in development. The program can be taken if students have passed the fifth semester (third year) offered in every academic year in odd/even semesters. This year the authors had the opportunity to receive an ITERA research grant and collaborated with students as a means for internships.

In searching the answer of the paper’s objectives, the authors share a google form as an effort to prevent direct contact with respondents. The questionnaires are based on the Trebilcock’s model with addition to research-based internship context. Some of the questions contained in the survey are:

| No. | Questions                                                                 | Aspect                                | Research Objectives      |
|-----|---------------------------------------------------------------------------|---------------------------------------|--------------------------|
| 1   | Are environmental factors an important consideration in making design/finding decisions on your internship? If so, why is it important? | Environmental ethics                  | Attitudes                |
| 2   | Is there any social involvement in your internship? if so, was it "new" to you? how did you feel in the process? please explain. | Social engagement                     | Attitudes                |
| 3   | How do you respond in understanding the environmental context to your internship? | Architectural sciences                | Explicit knowledge       |
| 4   | What environmental sustainability strategies/principles can be applied to your internship location? please explain. | Principles and strategy of environmentally sustainable design | Explicit knowledge       |
| 5   | How do you know the socio-cultural context of your research-based internship location? please explain. | Analysis of socio-cultural context    | Tacit knowledge          |
| 6   | What is your view after observing the environment around your internship location? Is the environment sustainable? if not, what improvement should be done? please explain. | Critical appraisal of case study, design integration | Tacit knowledge          |
| 7   | What reflections/ thoughts on the environment did you obtain in your internship process? please explain. | Critical appraisal of case study      | Tacit knowledge          |
| 8   | How is the environmental context analyzed? Does it use software applications or involve measuring tools (physical tools)? What environmental components do you analyze? | Use of analytical tools, quantitative analysis of case study | Skills                   |
| 9   | How are your social/communication skills with those involved in internship before and after undergoing internship? please explain. | Effective communication                | Skills                   |
| 10  | Please leave a free comment on your research-based internship.            | Critical appraisal of case study      | Skills                   |

Basically, these questions can also be asked in a normal internship (design) or in a design studio course. In this study, the questions were asked to students who chose research-based internships affected by COVID-19. The author used the content analysis method in analysing primary data derived from answers collected in the google form. Referring to Elo et al [9] on how to apply qualitative content analysis, the formulation of content analysis follows several criteria, namely: (1) data collection method uses a google form to collect opinions/thoughts from interns who conduct research during the COVID-19 period. (2) The unit of analysis is limited to textual sentences from students google form answers (3) The population of students who take part in the research-based internship in 2020 and 2021 (4) The context of the question is the experience gained during the research-based internship process related to environmental sustainability aspects. The sampling technique was purposive sampling. This was done because of the consideration that the sample taken was only students who took research-based internship. There were 10 students who took part in the research-based internship and were eligible for in-depth interviews.
3. Results and discussion
The results of the survey form reveals that there are 10 students who are willing to participate in the survey. Thus, the sample does not represent the entire population. In this chapter, answers from students will be presented based on questions derived from the description of the Trebilcock model above.

3.1. The attitude of students in delivering sustainable thinking
Discussions related to student attitudes include environmental ethics, analytical attitude, and social engagement. Students are asked questions regarding the urgency of environmental factors in considering design decisions and the social engagement experience obtained during the internship. From the knowledge of incorporate environment sustainable into architecture education, the students are fully aware that environment is an absolute factor for design decision and can have a huge impact on the destruction of surrounding environment. However, it seems that the awareness of environment has not been comprehended by students once dealing with their response in internship context, since their understanding is solely adequate, and still face difficulties in implementing the solution for environment issue. Perhaps, this lack of environment decision due to the habitual of design process that rarely engage the community and observe its surrounding directly.

Ten students, all of them wrote the answers in Indonesian, then translated into English by the author, but still maintained the originality of meaning that was written. Some students gave short answers, but there were also long answers and covered many aspects. Answering the question about the importance of environmental factors as an important consideration in design, they believe that the environment is the key in design decisions / findings. The answer from students is delivered through text and the identity of respondent represented by initials. For example, the following is the response from RDS referring to the question regarding the urgency of considering environmental aspect in their internship project: "because the design decision must adapt to the problems or needs that exist in the surrounding environment, for sure, these environmental factors will seek solutions that are also beneficial for the surrounding environment". In more depth, ANP wrote that: "yes, (the environment is very important) because it needs to get approval so that the place can be developed without disturbing the existing environment and local residents are not marginalized in their interests to fulfil the needs of a better life". With a similar view, RP states that: "environmental factors will affect the design in terms of thermal comfort, such as psychological, physiological, and behavioural patterns of a person feeling comfortable doing something with a supportive environmental condition".

Furthermore, the answers to the questions in understanding the environmental context are quite varied. Most of them understand enough because they are familiar with the research location. As AMS put it: “the environmental context is easy to understand, because we research at ITERA which we often experience the place, so it is easier to research.”. Environmental context is also seen as a source in the search for design solutions, according to RDS: "environmental context is very important in internships, where the environment will be analysed and can be a solution so that I can develop into ideas". Students have thought about making the context of the environment as the main determinant of problem solving, and in terms of convenience, students feel more familiar with the environment they often go through and do not experience problems when analysing it.

3.2. The sustainability knowledge obtained by the students
The subject of student’s knowledge regarding sustainability encloses explicit knowledge and tacit knowledge. The explicit knowledge approach tends to be found in education through the curriculum by inserting sustainability material in courses. The aspect of explicit knowledge consists of principles and strategies of environmentally sustainable design, architectural sciences, scientific and technical language. Students are asked questions about efforts to understand the environmental context in their internship, and strategies or sustainability principles that can be applied in their internship locations.
Meanwhile, tacit knowledge includes the socio-cultural context at the internship location, students' views after observing the environment and reflection on the environment during the internship process.

In this study, the question regarding strategies/principles that can be applied to the internship location are answered with several approaches. One of the students, SI argues: "In my opinion, ecological principles can be applied to pay attention to the existence of open spaces and limited house construction, it is also better to apply the engagement principle to increase and participate in community development processes". Almost like SI, RDS focuses more on material and vegetation strategies as in the following quote: "the location may be provided with vegetation and the use of materials that have less impact on the environment is highly recommended, so that the location can invite residents to socialize."

Furthermore, in the process of searching for the right strategies and principles, knowledge of the social and cultural context is also needed. The answers on how to find out the socio-cultural context of the internship location are mostly carried out by direct surveys, namely by interviewing, socializing with residents, observing, some even pay attention to body language, clothes worn, language and expressions. ANP for example, said: "by observing directly at the location, in this case many residents socialize in several places such as village posts and shop house ("warung"). The next way is to interact directly with residents, such as asking about socio-cultural activities that are often carried out in that location". In contrast to ANP, MFS tends to make observations with the following quote: "by analysing the relationship between the facilities provided by the park and visitors to the park.". Those answers give insight about how the students deals with uncertainty when they did the location survey. Since one method may not be suitable with for all, the experiences gained during the internships process enrich their ability on solving real problems in the area and they can refer to the method they used when facing the similar case in the future.

The connection with the socio-cultural context is implied in the next question, namely social involvement in internships. Six out of ten students felt that social involvement was new for them. As MKD explained as follows: “Yes, in this internship process I gained experience in interviewing informants with prepared questions and impromptu.” Agreeing with MKD, MFS also said that: "This is a "new" thing for me personally, I feel I have learned new knowledge, especially in developing a comfortable built environment for all level of society based on universal design.". SI also feels the same way: “What I felt in the process was that I was able to learn new things that I had never met or heard from the community, especially coastal communities whose stories and sufferings might never reach the government.”.

3.3. The skills of students regarding sustainability thinking

The aspect of students’ skills in terms of sustainability thinking consists of design integration, use of analytical tools, and effective communication. In this regard, the students are asked questions about technique in analysing environment context and their communication skills as well as free comment regarding their research-based internship.

An understanding of the analytical process is also implied in the questions about students' views after observing the environment around the internship place. Seven out of ten students think that the environment is unsustainable, ranging from the lack of green areas to the lack of public facilities. According to ANP: "The environment is not yet sustainable, improvements that can be made are providing green areas around the residents' neighbourhoods, as well as a better drainage system". Besides that, RP argues that “I think it can be sustainable or not, because the environment is very quiet and can be said to be like a dead city when it gets late. But it can be sustainable by generating public facilities, social facilities, and adding housing and settlements.”

Furthermore, in the aspect of the analysis process, it is known that students use various analytical media, ranging from physical tools and software depending on the outcome of the topic of their research-based internship. One of the students who took part in product-based research said that "(environmental context), it is analysed, calculation by taking temperature data from each room. Using
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research)
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- important that other people and myself understand information more accurately and quickly. MKD felt
the same way: “before the internship, I felt very stiff in conducting interviews and was still confused
about making a bridging before getting to the core of the question. After running one interview with
the supervisor, I am already good at communicating and even learning from the resource person.”
(MKD). Unlike the two students, for an internship that examines an inanimate object (product-based
research), communication is not used too much, as AMS said: "At this internship, we do not involve
many people, so our communication skills did not develop."

Furthermore, in addition to the survey questions, students were asked to provide free comments on
the internship process they underwent. The answers are varied. ANP said: “In carrying out the
internship activities so far, I have felt something new. Previously, in undergoing the design process in
architecture lectures, I did not do an analysis that led directly to the community, from here I learned
more to socialise and learn from people. Hopefully, this research can be completed properly and
maximally.” (ANP). Another student expressed his joy: “Thanks for the knowledge and experience,
our research-based internship taught me to care more about the environment around me.” (MFS). RP
felt the same way: "It's very exciting to go to the field, because activities like this cannot be found in
other courses.". RDS also had a new experience: “This research-based internship is quite interesting
socially. I get experience, because it is not only researching but also designing, it is quite a new
experience, because before designing in an architectural design studio, I rarely did research on the
location I was going to design, so this internship provides an opportunity to do research and hopefully
will hone my analytical skills.”

4. Conclusions
Architecture projects varies from housing to new town construction. All that matter starts with the
thought of architect in delivering client’s desire and needs. [10]. In the context of learning to make a
decent design decision, the students need to be sensible to the environment in which many interests
may interrupt and muddle during the decision-making process. In this case, the design studio tends to
exclude that conflict interest since it is far away from the student’s learning scope. In fact, those
potential issue hypothetically can be seen in the internship which confront wider stakeholder.

Learning in research-based internships provides reflections that come from experiences during
internships, as well as knowledge, and skills acquired during lectures. Regarding the COVID-19
condition, the context of thinking about environmental sustainability in architecture education cannot
be removed because it is one of the contributions in achieving the sustainable development goals
(SDGs). The internship process in the architectural study program of ITERA attempts to adapt and provide solutions by providing research-based internship opportunities to students under the guidance of lecturers. However, the performance of the research-based internship has never been studied empirically, so this study aims to find out and evaluate the integration of environment sustainable thinking with research-based internship.

The attitude of students in thinking sustainable based on the survey reveals that most of the students understand that environment as an important determining factor in formulating decision design. The understanding of environmental context also varies depending on the location of the internship. On the other hand, although the environmental factors are known as the determining factor, students are still weak in implementing environmental sustainability strategies/principles used in internships. This can be a material for reflection at architectural education in ITERA, namely the method for delivery the lecture.

Apart from these shortcomings, there are positive aspects, namely related to social involvement, and using certain analytical techniques in internships. From the social side, many students feel a positive impact on increasing their ability to interact with the community that has never been experienced before. Moreover, students feel more confident in conducting environmental and social analysis because they interact intensely and are directly involved in research, especially in research discussions. From the above findings, it can be concluded that research-based internships can strengthen environmental awareness, social interaction skills, and context analysis. In addition, this activity can also be an option for students to be able to improve interpersonal skills which is also the goal of internships in general. In the realm of architectural education at ITERA, the delivery of lectures on actions/strategies and principles of environmental sustainability needs to be improved.

Acknowledgement
Authors would like to thank to Institut Teknologi Sumatera for providing the research grant (No. B/498/IT9.C/PT.01.03/2021) through “Hibah Penelitian ITERA 2021”. This study also cannot be conducted without the active participation of our beloved students therefore, we highly appreciate their willingness in taking part at this research.

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