Implementation of the Environmental Education in Building and Civil Engineering Study Program of Universitas Negeri Makassar, Indonesia

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ABSTRACT
Environmental education is an essential part of the character development of students. Integrating environmental education has been proven to encourage students' abilities to understand, make decisions and act to prevent environmental damage. This study uses a mixed method, namely a quantitative approach with a checklist method, to find patterns of integration of environmental education in courses in the Building and Civil Engineering Study Program. At the same time, the qualitative method uses the interview method to find a description of the material and the student's learning achievement. The analysis results illustrate that the issues of global warming and waste management are the dominant materials in the application of environmental education. The application of environmental education has succeeded in developing students' knowledge in understanding issues and their causes. In contrast, the development of knowledge about problem solutions is still low.

Keywords: *Environmental Issues, Problem Solution, Learning Material.*

1. INTRODUCTION

The quality of human life is closely related to environmental conditions. Environmental damage such as pollution, erosion and forest fires in many areas of the world have impacted people's health conditions, poverty and life expectancy. Environmental degradation in developing countries generally occurs due to increased human population. The exploitation of natural resources to fulfill human needs has resulted in a decrease in environmental quality.

Rapid population growth continues to threaten the sustainable use of natural resources. It reduces the quality and quantity of natural resources through over-exploitation so that areas with high population pressure face scarcity of arable land. The growth of the world's population has changed the dynamics of natural resource utilization patterns and increased the risks of climate change. As a result, most of the human population is increasingly difficult to adapt to changes in the global environment.

The concept of sustainable development, which has become the initial basis for joint efforts to overcome environmental damage has been introduced for over three decades. However, human awareness of saving the environment has not yielded positive results. Innovative technology to anticipate climate change and the other fact of environmental degradation is of no benefit without the support of human awareness. The application of environmental education is an essential instrument in saving the environment [1].

Environmental education is a process to build awareness and concern for all human beings in the world for actions to save the environment [2][3]. In addition, this education also educates individuals to be responsive to local and global environmental problems. With this system, this education also trains individuals to have skills that contribute to productivity while maintaining and preserving nature [4][5].

Specifically, the urgency of implementing environmental education for civil engineering study programs increases students' knowledge of environmental degradation. Ecological damage due to construction activities is the initial form of knowledge formation. Furthermore, students' thoughts will develop into attitudes towards efforts to reduce the risk of damage. Simultaneous learning processes throughout

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the educational process will produce skills and abilities to solve environmental problems.

Civil engineering education in tertiary institutions aims to produce a skilled workforce in designing proper building structures with optimal utilization. The building design includes land survey activities, measurements and material strength calculations. In addition, civil engineering experts also can supervise structural work, which provides for monitoring the quality and quantity of materials and proper work methods. Civil engineers are responsible for making decisions about the selected building materials, work methods and the selection of supporting equipment. These three activities have a significant impact on the risk of environmental damage. Thus, the urgency of ecological education in civil engineering study programs becomes essential and impacts reducing the risk of environmental damage due to work and maintenance of building structures.

Based on this description, this study reveals the implementation of environmental education in civil engineering colleges. As an initial study, tracing the curriculum and pattern of implementation of environmental education is the focus of the study.

2. RESEARCH METHOD

Researchers used a mixed method technique that combines quantitative and qualitative methods. The subject of the study is the civil engineering study program at Universitas Negeri Makassar. This subject was selected because this study program is a very young institution and has operated for less than five years. Quantitative data collection used the checklist method on the applied curriculum and calculated the percentage of environmental education implementation on the cognitive, affective and psychomotor aspects. The second calculation in this process is the percentage of courses that develop student competency in three knowledge focuses: knowledge of issues, knowledge of problems and problem solutions.

The qualitative method includes an interview process with lecturers on subjects related to the pattern of implementing environmental education. Furthermore, the results of these interviews were validated with the results of interviews with students as a triangulation process. Researchers involved five lecturers and twenty students in the interview process. Methods of data analysis using reduction techniques, presentation and conclusion.

3. RESULT AND DISCUSSION

The analysis of environmental education implementation in the Civil Engineering Study Program begins with curriculum analysis. The curriculum includes 49 engineering courses divided into nine practicum courses and the other are theory courses. All classes are designed to develop student knowledge about structural analysis, construction management and building material. Specifically, the objectives of learning activities in the three aspects of knowledge are directed at cognitive, affective and psychomotor aspects. The cognitive element is a mental activity that enables an individual to relate, assess, and consider a situation. There are six cognitive abilities levels: knowledge, understanding, application, analysis, evaluation and creation.

In comparison, the affective aspect is the development of a person's thinking that encourages the attitude to act. This aspect is manifested by the tendency to receive, respond, assess and organize or manage. The psychomotor element is characterized by the ability to imitate, willingness to act, ability to respond, explain mechanisms, adapt and create.

Based on the grouping of knowledge aspects, the distribution of knowledge development in the three elements is revealed in figure 1.

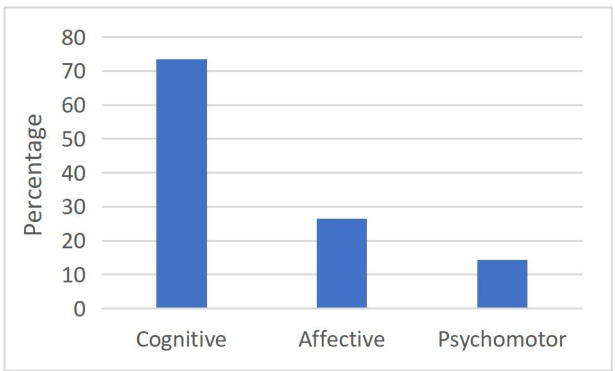

Figure 1 The Percentage of Courses by the Knowledge Aspect Target.

The analysis results based on the substance documents and learning objectives show that most courses develop cognitive abilities. In comparison, the affective and psychomotor aspects show a small percentage. Analysis of the application of environmental education contains the relationship between the content of learning materials and the development of student ecological knowledge. This knowledge appears in the ability to understand issues, causes of problems and solutions to problems. An overview percentage of the course that apply the development of environmental knowledge in the three components is revealed in Figure 2.

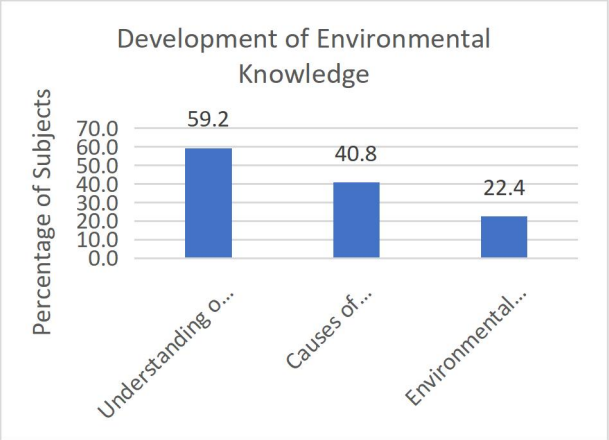

Figure 2 Three Aspects of Environmental Knowledge Aspects.

The number of types of environmental knowledge measures the level of application of environmental education. For example, the applied physics course develops knowledge about environmental issues and their causes, so this subject is included in the level two category. The wood structure course explains the issue of logging forests to meet the need for wood as a construction material. Besides that this subject also explains the causes of forest destruction if wood is used appropriately. This subject also trains students to apply an efficient wood utilization scheme that does not damage forest ecosystems. Thus, this course is included in level 3. Description of the application of environmental education is revealed in the figure 3.

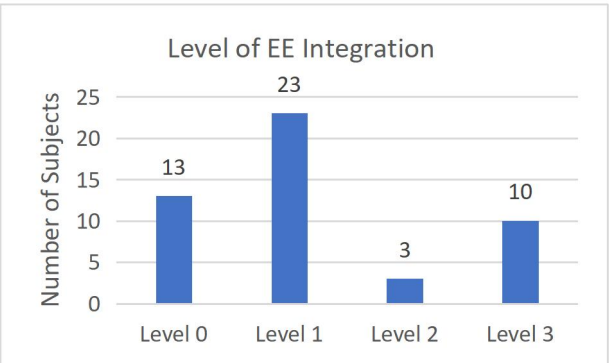

Figure 3 The Level of Environmental Education in All Courses.

Figure 3 shows that most of the courses integrate environmental education at level 1. There are even 13 subjects that are included in the level 0 category because they do not apply increased knowledge about environmental issues.

The analysis on the development of environmental education content includes ten types of issues. In detail, the description of the implementation of environmental education is revealed in the figure 4.

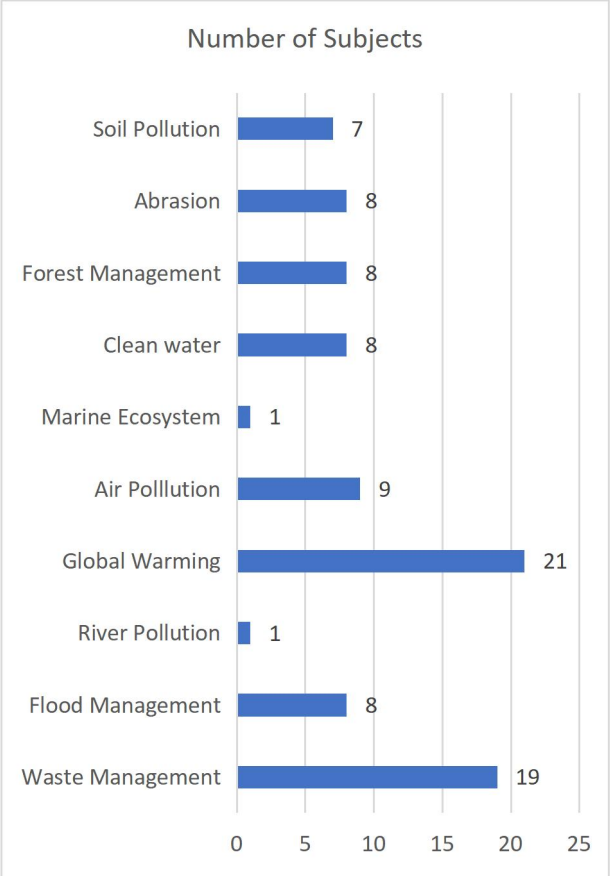

Figure 4 Environmental Topics in Environmental Learning.

In content analysis, the introduction of environmental issues is found in several courses. The description of the integration of environmental education with courses in civil engineering study programs is as follows:

- Building materials introduce six issues: waste management, flood prevention, river pollution, global warming, air pollution and forest management. This course aims to provide students with an understanding of the optimal use of materials without causing the risk of environmental damage.
- One of the topics in the heavy equipment management course is calculating the capacity of heavy equipment in earthmoving work. The calculation describes the use of fuel in mechanical equipment. The course also introduces the impact of inefficient fuel use on the risk of global warming. In addition, the maintenance of heavy equipment will reduce exhaust emissions. With this description, this course develops student knowledge about global warming.
- Building Assessment is a course that explains the importance of assessing a building against existing

damage. These assessment activities are generally held when a building experiences a disaster or disturbance. Another case that requires an assessment is the lack of long-term care. The results of this assessment can identify damage to each structural element. The next step is to make repairs if the damage is still minor or moderate. However, if the damage is at a significant level, then demolition measures are taken. This course provides direction for building demolition if damage occurs to a building because the demolition action will have the opportunity to produce waste that cannot be maximally reused.

- The Structural Strengthening Engineering course contains ways to repair a structural element, so there is no need to build a new building. New development of structural elements requires a lot of natural resources. Several strengthening methods can be used in structural repair, including jacketing techniques, fibre plastering, or shotcrete. This course also introduces repair techniques based on the concept of green building. One of them is strengthening by using bamboo reinforcement, replacing steel reinforcement.

- In the material testing laboratory, the introduction of material quality testing brings students' awareness of the selection of materials that has a negligible impact on environmental damage. Using sand with optimum volume in concrete mix design testing can raise students' understanding of the wise and not wasteful use of natural resources.

Environmental education in the civil engineering study program is going well. However, the dominant development of knowledge is the cognitive aspect or understanding of the problem. In contrast, developing students' skills in preventing the risk of environmental damage shows a relatively small contribution. Thus, implementing ecological education in tertiary institutions is ineffective and impacts the low attitude of civil engineering students in protecting the environment. As the knowledge theory about Anderson and Krathwohl–Bloom's taxonomy, knowledge is the ability to record problems and related concepts. Then with this knowledge, students can systematically explain about the mechanism of change of an event. The next level is the ability to apply the concept in solving a problem [6][7]. Based on this theory, environmental education can only stimulate and describe students' knowledge about environmental damage. But the ability to find solutions to problems is relatively small.

With these facts, lecturers should be aware of the importance of developing integrated environmental learning methods in the course. One of the effective methods is the presentation of local issues related to construction development. Local issues in question are facts that can be seen and described in detail and easily understood by students. The learning method that can be applied is experiential learning or giving students direct experience, transforming this experience into knowledge. One form of the learning model is Kolb's experiential learning cycle which consists of four stages: 1) Watching, 2) Thinking, 3) Doing, 4) Feeling [8][9]. The watching stage provides opportunities for environmental issues related to construction work. The Thinking stage encourages students to be able to conceptualize the problem and describe it systematically about ecological damage. The Doing stage encourages students to develop their thoughts about appropriate actions in solving environmental issues. The Feeling stage stimulates students to express their opinions or perceptions of environmental problems and their problem-solving methods. This stage is an opportunity for students to express their attitude towards environmental problems.

For example, students' understanding of landslide events that occurred during construction work forced engineers in the field to be able to determine anticipatory actions. The development of understanding through Kolb's experiential learning cycle is presented in the figure 5.

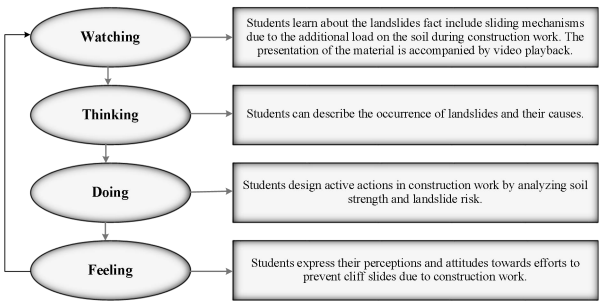

Figure 5 The development of understanding through Kolb's experiential learning cycle.

Development of student knowledge and attitudes will produce graduates who have high job readiness. Environmental education in tertiary institutions is also needed to prepare a workforce capable of dealing with all situationsCivil engineering education requires good structural analysis skills, and graduates must also have a sense of environmental responsibility. This attitude will give birth to the right actions in construction projects with minimal environmental impact. A person's lifestyle indicates an understanding of environmental responsibility [10-15]. The description above illustrates that higher education policies in Indonesia must encourage implementing practical and applicable environmental education. Environmental education is a

significant part in the formation of comprehensive human resources that can anticipate the dynamics of work needs.

4. CONCLUSION

The application of environmental education in civil engineering study programs generally focuses on students' cognitive development. Meanwhile, affective and psychomotor development is relatively limited. In general, lecturers develop students' knowledge of environmental issues. The dominant issues that become environmental education topics are global warming and waste management. Universities should formulate appropriate integration patterns with limited integration conditions by utilizing local and international environmental damage facts.

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