

A literature review: geography learning based on microlearning to increase student's ecoliteracy

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Abstract. Geography teachers find the difficulty to use geography learning to increase the students' ecoliteracy because the scope of geography subjects is very wide. In fact, ecoliteracy is a provision for students to overcome environmental problems that are getting worse. Therefore, this study aims to design geography learning based on microlearning to increase students' ecoliteracy. The method used is a literature review with descriptive analysis. The results of the research are the design of geography learning based on microlearning which includes (1) mapping of ecoliteracy microcontent in geography learning, (2) implementation of geography learning based on microlearning, and (3) geography learning media based on microlearning to Increase ecoliteracy. The conclusion is that geography learning based on microlearning needs to facilitate geography teachers in utilizing geography learning to Increase students' ecoliteracy.

1 Introduction

Environmental issues at the international and national level are getting worse day by day. Environmental issues being faced by Indonesia are extreme weather, deforestation, forest fires, erosion and silting of rivers, plastic waste, increasing critical areas, decreasing quality and quantity of groundwater, extinction of flora and fauna, marine pollution, and densely populated settlements [1].

The rate of deforestation in Indonesia is one of the highest tropical primary forest deforestation in the world [2]. The net deforestation rate in Indonesia in 2019-2020 is 115.5 ha [3]. Deforestation in Indonesia is also the cause of various environmental problems. Deforestation accompanied by forest burning activities causes air pollution that can threaten public health [4]. In addition, deforestation also contributes to the destruction of ecosystems and the extinction of several flora and fauna [5]. Forest damage due to deforestation can also damage water catchment areas upstream and result in catastrophic flooding in downstream areas [6].

Plastic waste is an environmental issue that must be considered because it is non-biodegradable and harmful to organisms. Indonesia is one of the largest plastic contributor countries in the world after China [7]. The production of plastic waste in Indonesia is very high, reaching 11.9 tons per day [8]. One of the real impacts of poor plastic waste management is pollution of marine ecosystems [9]. Many marine organisms die from ingesting

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microplastics that break down in the ocean. Not only that, plastic waste that is not managed properly can also disturb the view, clog the flow of the river, and pollute the river. If these environmental issues are not prevented and addressed immediately, they can have a greater impact in the future [10].

Therefore, ecoliteracy must be learned by students as early as possible [11]. Ecoliteracy can be interpreted as one's understanding of the principles of ecosystem organization and its application to create a sustainable society and environment [12]. Ecoliteracy is the awareness in making decisions and obtaining information to act in solving environmental problems [13]. So, with the ecoliterated generation, it is expected that environmental issues that occur today do not have a major impact in the future.

Geography subject has an important role to teach ecoliteracy because it contains a lot of materials that deal with ecoliteracy. However, many geography teachers have difficulty using geography learning to increase students' ecoliteracy because geography materials are very wide. Therefore, a learning approach is needed. One of them is the microlearning approach.

Microlearning comes from the word "micro" and "learning" which means learning done on a micro-scale but there is no fixed definition of microlearning. Microlearning can be defined as an approach to explaining one specific concept by utilizing multisensory and multimodality [14]. Another opinion also says that microlearning is a form of learning designed to deliver material in small parts in a short time [15]. More specifically, microlearning is short-term learning through electronic devices that can be accessed anytime and anywhere [16]. It can be concluded that microlearning is an approach to explain material into small parts that are delivered briefly and densely so that it is easy for students to understand.

The microlearning approach has characteristics that distinguish microlearning from traditional learning or macrolearning. These characteristics can be seen in terms of time, the form of learning, and the learning media used. In terms of time, macrolearning allows learning to be done in one hour more, while microlearning is done in less than 15 minutes [17]. Therefore, microlearning enables effective and efficient learning [18]

Content on microlearning only focuses on one topic, while on macrolearning learns several topics in one learning activity [14]. Some literature refers to it as "smallchunks", "microcontent", "single topic", "content fragment", and "bite-size". Such short materials can be presented through several types of media. Media used in microlearning can be presentations, podcasts, infographics, motion graphics, video explainers, and video conferences [19].

The advantage of microlearning is that it can make subjects easier to understand and remember for a longer time as well as increase the effectiveness and efficiency of learning [18]. Microlearning combined with LMS can also allow students to access learning materials anytime and anywhere [20]. So, microlearning is very suitable to be applied to various digital platforms to support the ease of access to materials by students. But the disadvantage of microlearning is that it is not suitable to do deep learning if you have to limit the material [21].

Through microlearning, geography teachers can break down learning materials into small parts or microcontent. Microcontent is a way to present information in a short and simple form [20]. So, geography teachers can choose and break down some materials that are closely related to ecoliteracy and teach them to students in a short but meaningful. Delivering material with an effective microlearning approach to making the material easy to understand and memorable over a long period of time [18].

The implementation of geography learning based on microlearning to increase ecoliteracy needs to be designed and developed. Therefore, this research aims to design geography learning based on microlearning to increase the students' ecoliteracy.

2 Methods

The study used a literature review with qualitative descriptive analysis. The aim is to design a microlearning-based geography lesson to improve the ecoliteracy of students. This research was conducted in three stages. First, the researcher collected secondary data on ecoliteracy and microlearning from various sources such as scientific articles and books. Second, the data is classified into several categories, namely microlearning concepts and theories, ecoliteracy concepts and theories, ecoliteracy microcontent mapping in geography learning, implementation of microlearning-based geography learning, and microlearning-based learning media. Third, the researcher analyzed the results of the literature review with a qualitative descriptive analysis and then discussed it into a complete study.

3 Results and discussion

3.1 Microcontent Ecoliteracy on Geography Learning

One of the characteristics of microlearning is the presence of microcontent. As we know, microcontent is a way of conveying material briefly and simply [20]. So, the large material can be broken down into several simple topics and delivered concisely. This method can be used to select geography content that very wide and choose certain content to teach ecoliteracy.

In the geography curriculum at K-13 Revision at the high school / MA level, there are 18 materials taught starting from grades 10, 11, and 12. Each material has a very broad sub-material. Based on the results of the collection of research analysis data, obtained materials and sub-materials that can be used as *microcontent* ecoliteracy are as follows.

Table 1. Materials and Ecoliteracy Microcontent in Geography Subjects in High School

No	Content	Microcontent Ecoliteracy
1	The Dynamics of the Lithosphere and Its Impact on Life	Utilization and conservation of soil
2	Atmospheric Dynamics and Their Impact on Life	The global impact of warming on climate change
3	Hydrosphere Dynamics and Their Impact on Life	Water pollution and conservation
4	Flora and Fauna in Indonesia	Distribution of Flora and Fauna in Indonesia
		Conservation of Flora and Fauna in Indonesia
5	Natural Resource Management in Indonesia	Distribution of natural resources in Indonesia
		Damage to natural resources in Indonesia
		Environmental Impact Analysis (AMDAL)
		Sustainable Development
6	Food Security, Industry, and Energy	Potential new and renewable energy resources
7	Population Dynamics in Indonesia	Population issues

8	Concept of Territory and Spatial Planning	Spatial Planning in Indonesia
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From the results of the analysis, there are 12 ecoliteracy microcontent materials in the geography subject. The determination of ecoliteracy microcontent is based on the ecoliteracy indicators presented by Fritjof Capra which include head/cognitive, heart/emotional, hand/active, and spirit/connectional [12]. Based on curriculum adaptation and ecoliteracy theory, the pattern of microcontent ecoliteracy in geography learning can be described as in figure 1.

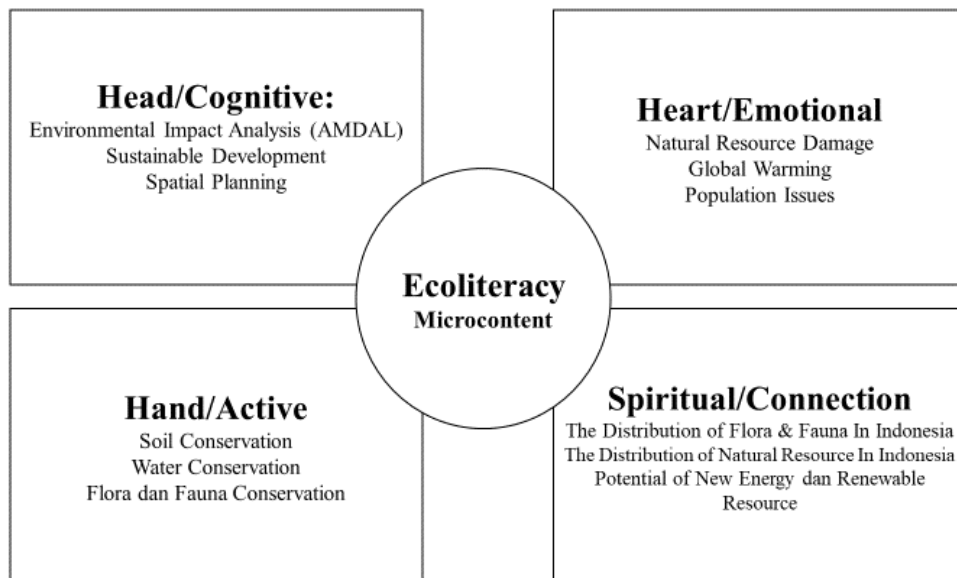


Figure 1. Ecoliteracy microcontent

3.1.1 Head/Cognitive

Cognitive competence is the ability of humans to understand life as a complex system, understand basic principles of ecology, think critically, assess the adverse effects of human actions on the environment, and predict the long-term impact of decision-making in the present [12]. Microcontents that are in accordance with these competencies are about “AMDAL: Environmental Impact Analysis”, “Sustainable Development”, and “Spatial Planning in Indonesia”.

Microcontent on "AMDAL" and "Sustainable Development" can assist students in assessing the bad effects of human actions in making decisions. It is suitable with the purpose of AMDAL that prevent environmental damage due to human activities in exploiting natural resources [22]. Sustainable development is also a major focus that must be understood by humans in the principle of ecoliteracy [23], [24]. While a microcontent on the "Regional Spatial Plan" can help students predict the long-term impact of development in a region. In accordance with the objectives of “Regional Spatial Plan” according to Law No. 26 of 2007, namely to realize a safe, comfortable, productive, and sustainable national space [25].

3.1.2 *Heart/Emotional*

Emotional competence is demonstrated by attention, empathy, respect for others and the environment, respect for differences in ways of thinking, and commitment to equality and justice towards all people [12]. This competence can be increased by presenting information that can create the emotions of students. One way that can be done to touch the emotions of students is by "*make the invisible to visible*" [26]. The teacher must present environmental damage information that has not been known by students into the information that is easily understood. So the appropriate ecoliteracy microcontent to build students' emotions is the topic of "Natural Resource Damage", "The Impact of Global Warming", and "Population Problems".

Microcontent about "Natural Resources Damage" can help students realize that human activities such as forest burning, illegal logging, poaching, littering, and polluting rivers can cause damage to natural resources. While microcontent about "The Impact of Global Warming" can realize students that the world is not doing well and will get worse if awareness about safeguarding the environment is not applied. Microcontent about "Population Issues" will realize students about the threat posed by the population explosion.

These materials will affect the emotions of students and create students' awareness in acting so as not to damage the environment. If a person already feels (sick, anxious, scared, and angry) about human activities that damage the environment, then that's where emotion and empathy for the environment are awakened [27].

3.1.3 *Hand/Active*

Active competence or action is an effort of a person in making the tools and procedures needed by sustainable communities, turning beliefs into actions, and wise in using natural resource energy [12]. Action is important because without real action, concern for the environment becomes meaningless. Therefore, teachers must provide facilities to students to participate in environmental conservation [28]. So proper ecoliteracy microcontent are soil conservation, water conservation, and flora and fauna conservation.

Conservation can be defined as an effort to maintain or preserve the environment. Teachers can invite students together to do the conservation of water, soil, flora, and fauna around them. Conservation measures that can be done are by preserving, restoring, adapting, and revitalizing [29].

3.1.4 *Spiritual/Connection*

This competence is demonstrated by loving nature, respecting the earth and the living creatures that live in it, maintaining the environment in which it lives, being friendly with nature, and inviting others to feel the same [12]. This competence can be achieved by showing information about how rich natural resources are in Indonesia and how lucky we are. So students will feel proud of what they have and try to take care of it. Therefore, the appropriate ecoliteracy microcontent is "The Distribution of Natural Resources In Indonesia", "The Distribution of Flora and Fauna In Indonesia", and "The Potential of New Energy and Renewable Energy in Indonesia".

Through learning about the ecoliteracy microcontent, students become aware of the natural wealth owned by Indonesia. The students' understanding of the richness of nature and its function, will increase his love of nature [26]. Furthermore, the love of nature also affects the way a person consumes products based on green consumption and the principle of 3R(reduce, reuse, recycle) [30].

3.2 How to Implement Microlearning-Based Geography Learning

There are four ways to implement microlearning such as; (1) preparation before learning event, (2) follow-up to support learning event, (3) stand-alone training, and (4) performance support [31]. These methods are selected according to the situation and conditions of students and the learning goals to be achieved.

3.2.1 Preparation before learning event

The goal is to prepare student knowledge before learning activities take place. Teachers can present short videos, infographics, podcasts, short notes, or pretests. Teachers should explain to students that they can spend less than 10 minutes studying the material. Material can be distributed via e-mail, e-learning, WhatsApp, and so on. This method is suitable to be applied if; (1) students don't have a good understanding of the material to be studied, (2) a lot of material that students must understand, and (3) inequality of students' knowledge level [31].

The implementation to increase students' ecoliteracy is teachers can spread ecoliteracy microcontent that has been made the day before learning activities are carried out. For example, the ecoliteracy microcontent that must be studied is about "Natural Resources Damage" which is packaged in a short video. Teachers can share the short video via WhatsApp or Email. Then the teacher asks the student to spend 7-10 minutes of time watching the video the day before learning begins. So that students have a strong provision when learning takes place and teachers only need to deepen it.

3.2.2 Follow-up to support learning event

The goal is to maintain the students' retention of the material that has been studied. Based on the theory "*Forgetting Curve*" developed by Ebbinghaus that there will be a drastic decrease in memory within 24 hours after learning activities [32], [33]. But it will be different if the teacher gives a follow-up to students in the form of microlearning. Figure 2 shows the difference in retention of students who follow-up and as a result, they are able to maintain retention well (Torgerson and Lannone 2019).[31].

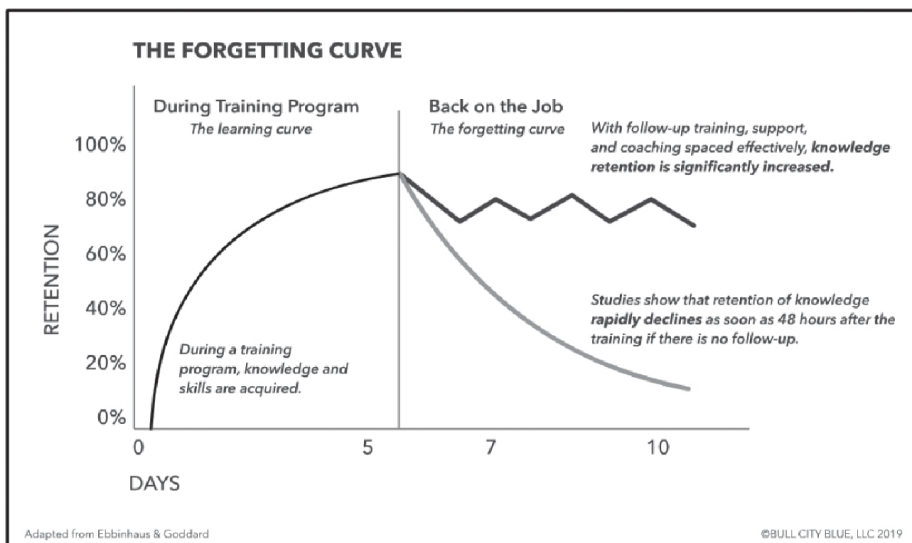


Figure 2. The Forgetting Curve

Teachers can use WhatsApp Group and E-Mail to spread microcontent such as articles, videos, infographics, problem banks, and podcasts after learning is complete as a form of *follow-up* to learning outcomes. This is the right way to do when; (1) Students need the material in carrying out their duties, (2) students may forget the important material learned, and (3) teachers want to continue learning outside of lesson or class hours [31].

For example, when learning teachers explain lithosphere materials with the topic of soil utilization and conservation. The teacher gives the task of giving examples of "Soil Conservation Methods" around where he lives. After learning teachers provide ecoliteracy microcontent about "Soil Conservation Methods" in the form of short articles. Students need this information to carry out their duties. If there is no such microcontent, it is likely that students will forget and not be able to carry out their duties properly.

3.2.3 *Stand-alone training*

One of the uniqueness of *microlearning* is that students can learn independently. The goal is to adjust the time and speed of absorbing the material for students. As we know, every student has different speed of responding and understanding information [18]. Teachers only need to spread microcontent in the form of short articles, short videos, infographics, or podcasts via e-mail or WhatsApp. Then students are asked to study it independently in less than 10 minutes. This is the right way to do when; (1) extensive material can be broken down into small parts, (2) material needs to be presented after learning is completed, (3) students already understand the basic concepts of the material, and (4) students have high motivation to learn the material. Therefore, it is necessary to arrange the material briefly and easily understood and design it as interesting as possible.

For example, as learning progresses students are given 10 minutes to learn about the ecoliteracy microcontent about the "Impact of Global Warming" presented in the form of printed infographics. The teacher shared the infographic sheet with the students. Furthermore, the teacher conducted a discussion from the results of independent observations made by students on the infographic.

3.2.4 *Performance support*

The purpose of this method is to provide guidance or guidelines against certain materials that are difficult for students to remember because of their complexity. Then this method is appropriately used when; (1) material is easily forgotten, (2) the accuracy of concepts and materials is important, (3) error-prone procedures, (4) material contains many important steps and points, and (5) many topics are important to guide student's task [31]. Teachers can deliver material in the form of work guidelines, videos, and notes.

For example, the teacher gave a practicum to the participants didik to create a "Map of the Distribution of Flora and Fauna in Indonesia". The teacher created a practicum guide containing tools and materials, practicum steps, and a list of flora and fauna in Indonesia that must be included in the map. The guide will be useful to guide students in working on their practicum.

3.3 Geography Learning Media Based on Microlearning

There are many learning media that can be used in microlearning. Based on the results of data collection and data analysis, the author presented some suggestions of learning media based on microlearning that are able to increase the ecoliteracy of students.

3.3.1 *Video*

Video is a medium consisting of audio and visuals that can be used to convey information or messages [34]. Video becomes a very flexible learning medium because it can be applied to direct, online, or mixed learning [35]. There are several types of videos that can be used and produced in microlearning, namely interviews, animations, live-action, and tutorials [31]. The recommended duration in one video is 5-10 minutes only.

Video media has the power to present material that can trigger the emotions and feelings of its audience [36]. This is very suitable to increase the ecoliteracy of students, especially for heart /emotional competence. Through video media, it is expected that students are touched by their hearts to live the ecoliteras microcontenti such as damage to natural resources, the impact of global warming, and population problems. However, video media is essentially suitable for all learning materials and all microlearning ways.

3.3.2 *Infographic*

Infographics can be interpreted as visualizing of the data, facts, and information on an image [37]. There are three types of infographics; (1) static: infographics in the form of images, (2) interactive: infographics that can be controlled by users such as through applications, and (3) infographic videos: infographics packaged in the form of short videos. Infographics have the power to convey information because it is easy to understand and can simplify information [31]. Teachers can create one infographic for one microlearning topic based on a predefined microcontent.

3.3.3 *Podcast*

Podcasts are audio or digital sounds that can be listened to by students [31]. Podcast media becomes the easiest medium to produce because teachers only need a voice recording device and a script to be read. To make an engaging podcast heard, teachers must create a concise, clear, easy-to-understand, and readable narrative with proper intonation. Podcast file formats can be in the form of mp3 or WAV which can be distributed via WhatsApp or E-mail. Podcasts contain short information ranging from 3-5 minutes according to the microcontent topic you want to convey.

3.3.4 *Interactive Multimedia*

Multimedia is a combination of various media elements such as sound, video, images, text, animation, and so on into a synergistic and integrated unity to provide benefits for its users [38]. When multimedia user can control the "what", "when", and "how" of some of the elements presented in a multimedia, it is referred to as interactive multimedia.

Through interactive multimedia, teachers can combine various microcontent with different formats in a single program or application. As has been done [39]. in making multimedia for microlearning-based mangrove conservation learning. The results showed that multimedia is effective for accessing learning independently and can be accessed anytime and anywhere.

4 **Conclusion**

Based on the results of research, we have found a design of geography learning based on microlearning to increase students' ecoliteracy that is divided into three parts. First, mapping

of ecoliteracy microcontent resulted in 12 topics that included four ecoliteracy competencies such as head/cognitive, heart/emotional, hand/active, and spiritual/connection. Second, implementation of geography learning based on microlearning to increase students' ecoliteracy is done through four ways; (1) preparation before learning event, (2) follow-up support learning event, (3) stand-alone training, and (4) performance support. Third, geography learning media based on microlearning that can be used include short videos, infographics, podcasts, and interactive multimedia.

The hope for the next research is that there is research developing a geography learning based on microlearning model and geography learning based on microlearning media as well as testing its effectiveness in improving the ecoliteracy of students.

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