THE DEVELOPMENT OF MICROLEARNING-BASED ON TEACHING MATERIALS TO INCREASE STUDENTS' ECOLITERACY

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Abstract. This study aims to (1) determine the validity of microlearning-based teaching materials, (2) determine the response of teachers and students to microlearning-based teaching materials, and (3) investigate the effect of microlearning-based teaching materials on students' ecoliteracy. The research method used was mixed research method or a combination of qualitative and quantitative approaches. The sample in this study were 63 students and 3 geography teachers at SMA Negeri 1 Belitang. The microlearning-based teaching materials developed are podcasts and videos. The results showed that (1) the results of validation tests by material experts on video teaching materials and microlearning-based podcasts received a very high score of 81%, while the results of validation tests by media experts on video teaching materials received a very high score of 94%, and podcasts received a very high score of 96%; (2) the geography teachers' responses to video teaching materials was very good with a score of 91.6%, and to podcast teaching materials were also very good with a score of 82.5%. While the responses of students to video teaching materials was very good with a score of 86.1%, and to podcast teaching materials were also very good with a score of 81.8%; (3) based on the results of the independent sample T-test, it is known that (a) there is an effect of using microlearning-based video teaching materials on students' ecoliteracy, (b) there is no effect of using microlearning-based podcast teaching materials on students' ecoliteracy, and (c) microlearning-based video teaching materials have higher effectiveness than microlearning-based podcast teaching materials in influencing students' ecoliteracy.

Keywords**:** microlearning; teaching materials; ecoliteracy

I. INTRODUCTION

Environmental problems occurring in the world are becoming more and more critical. The causes are human activities in utilizing natural resources unsustainably and several extreme natural phenomena (Salvia et al., 2019; Singh & Singh, 2017). Environmental problems even occur massively in developing countries such as Indonesia. In Indonesia, the dominant environmental problems are deforestation, water and air pollution, marine damage, extinction of flora and fauna, and densely populated settlements (BPS, 2016; Resosudarmo, 2012). This is supported by data on the rate of deforestation in Indonesia which is one of the highest primary deforestation of tropical forests in the world with a net deforestation value in Indonesia in 2019-2020 of 115.5 ha (KLHK, 2021; Margono et al., 2014). In addition, from around 4,000 watersheds in Indonesia, 108 watersheds were severely damaged by the large amount of garbage and waste thrown into the river

which resulted in flood disasters. This implies a flood disaster (Priyanti et al., 2019). Marine damage in Indonesia is also quite severe, according to Greenpeace data, 35.15% of coral reefs in Indonesia have been damaged (Roziqin et al., 2021).

It is appropriate that the current technological advances are utilized to overcome these various problems. One of the examples is by providing microlearning content related to the promotion of a sustainable environment. Microlearning is an approach that seeks to convey a specific concept in a short and clear time (Dolasinski & Reynolds, 2020; Zhang, 2005). One of the characteristics of microlearning is that it lies in the topic or material conveyed, that is, it only focuses on one topic in one content (Dolasinski & Reynolds, 2020). Thus, the audience or readers are not easily bored and can understand the content quickly. Utilization of microlearning content to promote sustainable environment has been carried out by the United Nations through the "UNSDG: Learn" programme by providing microlearning content on

sustainable development practices for environmental sustainability in their website.

It proves that microlearning is suitable to be applied in schools as one of the approaches to environmental learning because microlearning has the advantage of making subjects easier to understand and remember for a longer time and increasing the effectiveness and efficiency of learning (Mohammed et al., 2018). Microlearning combined with LMS can also allow learners to access learning materials anytime and anywhere (Kamilali & Sofianopoulou, 2015). In consequence, microlearning is very suitable to be applied to various digital platforms to support the ease of material access by students.

The subject of geography is one of the disciplines that has an important role in teaching sustainable environment to students. By utilizing microlearning content geography teachers can teach eco-themed content to students easily and briefly. It can overcome the breadth of material study in geography subjects (Lestari & Benardi, 2020). Geography learning about the environment is also very important to teach ecoliteracy to students. Ecoliteracy can be interpreted as a person's awareness in making decisions and obtaining information to act in solving environmental problems (Lewinsohn et al., 2015).

Ecoliteracy plays an important role for students, so that they can overcome environmental problems that occur now and in the future (Muthukrishnan, 2019). Understanding ecoliteracy is useful for students to become members of the community who have knowledge, attitudes and actions that care in maintaining the environment (McBride et al., 2013). Therefore, education becomes the main means in instilling ecoliteracy to give birth to a generation of ecoliterate people who care about the environment. Thus environmental issues that occur today will not get worse in the future.

Therefore, geography teachers need appropriate teaching materials to support the implementation of microlearning-based geography learning as a means of teaching ecoliteracy to students. Teaching materials are all forms of material or materials used by teachers to carry out learning (Depdiknas, 2008). Teaching materials become an important tool to improve the efficiency of teachers in teaching and improving students' learning outcomes (Ajoke, 2017). However, the existence of microlearning-based teaching materials to teach ecoliteracy to students is difficult to obtain. Based on the results of interviews with geography teachers at SMA Negeri 1 Belitang, it is found that there are difficulties to teach ecoliteracy to students due to the limited teaching materials related to ecoliteracy. Available teaching materials are still conventional such as printed books and modules. Teachers also still have some difficulties to make teaching materials independently. These constraints are in the form of limited time, limited facilities, and limited teachers' technical understanding in producing teaching materials for ecoliticization. Geography teachers are also still experiencing technical difficulties regarding microlearning and ecoliteracy in geography learning.

Therefore, researchers try to develop microlearning-based teaching materials to increase the ecoliteracy of students. In

this study, microlearning-based teaching materials will be compiled using BC 3.3 on "Natural Resource Management in Indonesia" in the eleventh grade social studies (XI IPS). The material was chosen because it is very appropriate to improve the ecoliteracy ability of students. The types of media in microlearning-based teaching materials used include videos and podcasts. Therefore, the purpose of this study is (1) to determine the validity of microlearning-based teaching materials, (2) to determine the response of teachers and students to microlearning-based teaching materials, and (3) to test the effect of microlearning-based teaching materials on student ecoliteracy.

II. METHODOLOGY

This study uses a mixed method. The mixed method is a combination of two research approaches, namely qualitative and quantitative in answering the formulation of research problems and hypotheses (Creswell, 2014). The qualitative approach is used to explain the validity of microlearning-based teaching materials and explain the response of teachers and students to microlearning-based teaching materials. While the quantitative approach is used to test the effect of using microlearning-based teaching materials on the ecoliteracy of students. The quantitative research design used pseudo-experimental research with pretest-posttest control group design. Researchers created three classes consisting of experimental class 1 that used microlearning-based video teaching materials, experimental class 2 that used microlearning-based podcast teaching materials, and control class that learned without special treatment.

There are three instruments used in this study, namely (1) validation sheets for material experts and media experts, (2) questionnaires for teacher and student responses to teaching materials, and (3) instruments for student ecoliteracy tests. The following are indicators of each instrument used in this study.

The material expert validation sheet instrument is assessed from (Depdiknas, 2008) those who have indicators, namely content conformity (conformity with BC, needs of students, needs of teaching materials, truth of material substance, usefulness, and conformity with moral and social values) and language (conformity with KBBI, Great Dictionary of the Indonesian Language, and effective and appropriate use of language). Indicators of media expert validation sheets are also fitted from (Depdiknas, 2008; Torgerson & Lannone, 2019) those with indicators, namely presentation (purpose, order of presentation, motivation, interaction, and completeness of information), graphics (use of fonts, layout, illustration, and display), and microlearning (ease of access, short delivery times, and ease of content selection).

Questionnaire instrument of students' and geography teachers' responses to teaching materials is based on opinions (Hadijah, 2018). Questionnaire indicators of students' responses to teaching materials consist of assessing the quality of material, the attractiveness of teaching materials, grammar, and the use of illustrations. Meanwhile, the indicator of the teacher's response to teaching materials

consists of the ability of teaching materials to overcome student experience limitations, overcome classroom boundaries, encourage students to maintain the environment, explain materials, and increase ecoliteracy.

Ecoliteracy test instruments were adapted from a variety of sources. The main idea of ecoliteracy indicators is adapted from (Capra, 1997), which states that ecoliteracy indicators consist of cognitive, emotional, spiritual, and action aspects. The following is a more complete elaboration.

TABLE I
ECOLITERACY INDICATOR

Indicators	Total of questions
Cognitive	
Ability to understand the basic principles of ecology	3
Understanding the ecological crisis due to over-utilization of natural resources	3
Taking into account the impact of human activity	4
Emotion	
Has a sense of care, empathy, and respect for others and the environment	2
Have a commitment to environmental sustainability and social justice	3
Spiritual	
Have a love and admiration for nature	1
Respect for the earth and the living things that live	1
Maintaining the environment in which they live	1
Friendly with nature	1
Inviting others to take care of the environment	1
Actions	
Able to use tools, procedures, and objects needed by a sustainable community	2
Turning understanding into practice	2
Wise in using energy	1
Total	25

Source: Adapted from (Capra, 1997; Cutter-Mackenzie & Smith, 2003; Dunlap, 2008; Hollweg et al., 2011; McBeth & Volk, 2009)

The respondents involved in this study consisted of one subject matter expert, one media expert, three geography teachers, and 63 students. The data analysis techniques used in this study are percentage analysis techniques and parametric statistical analysis. Percentage analysis technique is used to interpret the data of validity test results of microlearning-based teaching materials and the data of teacher and student responses to microlearning-based teaching materials. The following is the formula for the percentage analysis technique to be used (Arikunto, 2009).

$$Nilai = \frac{\sum Skor\ yang\ Diperoleh}{\sum Skor\ Maks} x\ 100$$

The results of the calculation are then used to interpret the level of validity of teaching materials and responses to teaching materials as follows.

TABLE II
VALIDATION CRITERIA FOR TEACHING MATERIALS

No.	Criteria	Score (%)
1	Very Feasible	80-100
2	Feasible	60-79.9
3	Less Feasible	40-59.9
4	Unfeasible	0-39.9

TABLE III
CRITERIA FOR RESPONSE TO TEACHING MATERIALS

No.	Criteria	Score (%)
1	Very Good	80-100
2	Good	60-79.9
3	Poor	40-59.9
4	Very Poor	0-39.9

Meanwhile, parametric statistical analysis was carried out by conducting an independent sample T-test. However, before conducting this test, it is necessary to test the normality and homogeneity of the data to be tested.

III. RESULTS AND DISCUSSION

The microlearning-based teaching materials developed in this research are videos and podcasts. In general, the process of developing teaching materials in this study has three stages, namely the pre-production, production, and post-production stages. However, in more detail, there are eight stages that must be passed as follows.

The first stage, the analysis of basic competencies (BC) and learning materials. The BC chosen is BC 3.3 on "Management of Natural Resources in Indonesia". BC and the material was chosen because it has a relationship with the variable of this study, namely ecoliteracy. The material must be broken down into small parts or microcontent, so that teaching materials can be referred to as microlearning-based teaching materials (Kamilali & Sofianopoulou, 2015). Thus, there are nine materials that will be applied to teaching materials, namely (1) the potential and distribution of forest resources in Indonesia, (2) the potential and distribution of mining resources in Indonesia, (3) the potential and distribution of marine resources in Indonesia, (4) the potential and distribution of tourism resources in Indonesia, (5) damage to forest resources in Indonesia, (6) damage to mining resources in Indonesia, (7) damage to marine resources in Indonesia, (8) Environmental Impacts Analysis (EIA), and (9) the use of Sustainable Natural Resources.

The second stage, is to determine the format of the media on the teaching material. There are various media that can be selected in microlearning-based teaching materials such as presentations, podcasts, infographics, motion graphics, video explainer, and video conference (Nugraha et al., 2021). However, in this study, the selected media were videos and podcasts. Video media is chosen because it has the

advantage of influencing one's perceptions and emotions. This is in line with the results of research (Finkler & Leon, 2019) which states that the video media has the power to present material that can spur the emotions and feelings of its audience. While podcast media is chosen because the process of making it is easy. In addition, learners can utilize podcasts to listen, record important material, and review missed material (Bolliger et al., 2010).

The third stage, is script writing. The script was created as a guide and reference for recording sounds, recording videos, and editing videos. There are nine manuscripts made according to the material in the teaching materials. Each transcript of the manuscript consists of three parts, namely the introduction, content, and cover. In the introduction section, it contains greeting sentences, material titles, and learning objectives. In the content section, it contains material taken from various sources such as books, journals, articles on the website, and statistical data. In the closing section, it contains conclusions and closing greetings. The structure follows the general structure of teaching materials consisting of preliminaries, contents, and covers (Depdiknas, 2008; Prastowo, 2015).

The fourth stage, is sound and video recording. Sound and video recording is done following the transcript of the manuscript that has been made. The sound and video recording process is carried out in a soundproof place to avoid outside noise and noise that can interfere with sound clarity. Video recording is carried out by utilizing the green screen method to facilitate the use of artificial background during the editing process. The sound and video recording process uses tools such as microphones, mirrorless cameras, and laptops.

The fifth stage, is the collection of additives. Some additional materials such as music, videos, photos, and animations that are not possible to create on their own should be collected from a variety of sources. The sources of providers of these materials are Youtube, Element Envato, and Google Photo. The addition of these materials serves to enhance the video, give a life impression on the sound, visualize objects that can support imaginative students so that they can help students understand the material well.

The sixth stage, is editing & mixing. All materials that have been collected such as sounds, music, videos, images, and animations are included in a video editing application, namely Filmora. Then the materials are arranged and arranged according to the sequence written on the teaching material script. So that microlearning-based videos and podcasts are produced that are ready to be tested by experts. The editing & mixing process acts as a means to organize, organize, and manipulate videos to be interesting (Susilana et al., 2020).

The next step is the validation test. The validation test was conducted by the media expert, Mr. Gema Rullyana, M.I.Kom. who is a lecturer in the Curriculum and Education Technology department, Universitas Pendidikan Indonesia. While the subject matter expert was Ms. Annisa Joviani Astari, M.Sc.,Ph.D. who is a lecturer in Geography Education at the University of Education Indonesia. The two

experts are selected on the recommendation of the supervising lecturer because they have competence in their respective fields. This is in accordance with the advice from (Prastowo, 2015), which states that experts are selected based on their competence and track record in research and development that is aligned with the teaching materials developed.

The eighth stage, is dissemination. Video teaching materials are disseminated through the Youtube platform. Youtube was chosen because it is easily accessible and is the most frequently used video viewing platform by teachers and students. This is in line with the results of the study(Qadriani et al., 2021), stating that 50% of teachers use YouTube to upload videos aimed at students to learn. Therefore, students and teachers do not need any more adaptation process to access YouTube. While podcast teaching materials are uploaded on the Anchor podcast platform. On the Anchor platform, there is a microlearning feature, so that the material on the podcast can be uploaded according to the desired topic or episode. In essence, microlearning-based teaching materials must be disseminated so that they can be accessed without being limited in distance, time, and cost (Torgerson & Lannone, 2019).
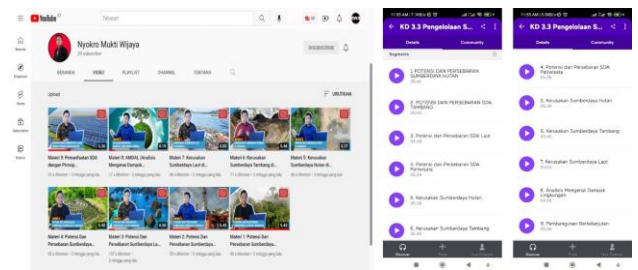

Fig. 1 Display of video and podcast teaching materials

A. Description of Validation Test Results of Teaching Materials

Microlearning-based video teaching materials and podcasts have the same content. Thus, the results of the expert validation test of video material and podcasts are combined. The results of the validation test of material experts on microlearning-based video and podcast teaching materials are as follows.

TABLE IV
VALIDATION TEST RESULTS OF MATERIAL EXPERTS ON VIDEO AND PODCAST TEACHING MATERIALS

Indicators	Score Acquisition (%)	Description
Conformity		
Conformity with BC	75	Feasible
Appropriateness to the needs of learners	87.5	Very Feasible
Conformity with the needs of teaching materials	75	Feasible
The truth of the substance of matter	75	Feasible

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Usefulness	93.75	Very Feasible
Conformity with moral and social values	87.5	Very Feasible
Language		
Readability	75	Feasible
Clarity of information	83.3	Very Feasible
Conformity with Indonesian rules	75	Feasible
The language used is effective and efficient	75	Feasible
Total Score Acquisition	**81**	**Very Feasible**

Based on these data, it can be seen that podcast and video teaching materials obtained a percentage of validation scores of 81% or received the category "very feasible". The highest score is found in the aspect of "Usefulness" which is 93.75%. In the aspect of benefit, the question items asked relate to the benefits of teaching materials in improving insight, attitudes, and actions of caring for the environment. This indicates that teaching materials have high power to increase the ecoliteracy of students. This is in line with (Orr, 1992) the opinion which states that ecoliteracy indicators consist of knowledge, attitudes, and actions caring about the environment. Teaching materials are constructed with the aim of teaching ecoliteracy to students.

Validation tests by media experts on podcast and video teaching materials are carried out separately because they both have different delivery media. The results can be seen in the following table.

TABLE V
VALIDATION TEST RESULTS OF MEDIA EXPERTS ON VIDEO TEACHING MATERIALS

Indicators	Score Acquisition (%)	Description
To serve		
Clarity of Objectives	100	Very High
Serving sequence	100	Very High
Provision of motivation or attraction	87.5	Very High
Provision of interaction	75	High
Completeness of information	100	Very High
Cegraphy		
Use of fonts	100	Very High
Layout	100	Very High
Illustration	100	Very High
Appearance	100	Very High
Microlearning		
Ease of accessibility and dissemination	100	Very High
Short conveying time	100	Very High
Interactivity Capabilities	100	Very High
Ease of recruitment and content selection	100	Very High

Total Score Acquisition	94%	Very High

TABLE VI
VALIDATION TEST RESULTS OF MEDIA EXPERTS ON VIDEO TEACHING MATERIALS

Indicators	Score Acquisition (%)	Description
To serve		
Clarity of Objectives	100	Very High
Serving sequence	100	Very High
Provision of motivation or attraction	87.5	Very High
Provision of interaction	75	High
Completeness of information	100	Very High
Microlearning		
Ease of accessibility and dissemination	100	Very High
Short conveying time	100	Very High
Interactivity Capabilities	100	Very High
Ease of recruitment and content selection	100	Very High
Total Score Acquisition	96%	Very High

Based on the data from the media expert validation test, it was concluded that podcast teaching materials had a higher validation value than video teaching materials. Video teaching materials scored 94% while podcast teaching materials scored 96%. However, both are still classified as having very high validation. Because both teaching materials have the same content. The difference between the two teaching materials lies only in their visual abilities.

B. Description of Teachers' and Learners' Responses to Teaching Materials

There are three geography teachers who respond to microlearning-based teaching materials. The teacher's response to teaching materials is necessary because of the position of the teacher as a practitioner who uses teaching materials to teach. The following is a comparison of geography teachers' responses to microlearning-based video and podcast teaching materials.

TABLE VII
GEOGRAPHY TEACHERS' RESPONSE TO TEACHING MATERIALS

No	Indicators	Video Teaching Materials		Podcast Teaching Materials	
		Response (%)	Desc	Response (%)	Desc
1	The ability of teaching materials to overcome the limitations of student experience	83.3	Very Good	79.2	Good
2	Ability of teaching	91.7	Very Good	83.3	Very Good

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No	Indicators				
	materials to overcome boundaries in the classroom				
3	Ability of teaching materials to encourage students to maintain the environment	95.8	Very Good	87.5	Very Good
4	Ability of teaching materials in explaining the material	87.5	Very Good	79.2	Good
5	The ability of teaching materials in increasing the ecoliteracy of students	100	Very Good	83.3	Very Good
	Average Score	**91.6**		**82.5**	

Based on the table above, it can be concluded that geography teachers provide an excellent response to microlearning-based video and podcast teaching materials. But video teaching materials get a better response by geography teachers. There are two aspects that are the weak points of podcast teaching materials when compared to video teaching materials. This weakness is related to the ability of teaching materials to overcome the limitations of student experience and the ability of teaching materials to explain the material. This is because podcast teaching materials only display sounds without displaying images and illustrations that can help students understand the material. So the ability of podcast teaching materials to explain the material and overcome the limitations of the students' experience is not as good as video teaching materials.

Furthermore, students respond to microlearning-based teaching materials that they have used. Theaspects assessed are about the quality of material, the attractiveness of teaching materials, grammar, and the use of illustrations and narratives in teaching materials. Experimental class 1 students of 31 students responded to video teaching materials. Meanwhile, an experimental class of 31 students responded to podcast teaching materials. The following is a comparison of the results of both studies.

TABLE VIII
STUDENTS' RESPONSES TO TEACHING MATERIALS

No	Indicators	Video Teaching Materials		Podcast Teaching Materials	
		Response (%)	Desc	Response (%)	Desc
1	Quality of Materials	82.5	Very Good	84.7	Very Good
2	The Fascination	87.1	Very Good	79.0	Good

No	Indicators	Video Teaching Materials		Podcast Teaching Materials	
	of Teaching Materials				
3	Grammar	85.9	Very Good	83.1	Very Good
4	Illustrative and Narrative Use	89	Very Good	80.4	Very Good
	Average	**86.1**		**81.8**	

Based on the table above, it can be concluded that video and podcast teaching materials received a very good response. But video teaching materials get a better response than podcasts. The aspect of the attractiveness of teaching materials becomes the weakness of podcast teaching materials because it only gets a "Good" response from students. This is very reasonable because podcast teaching materials only display narratives or sounds without displaying images that can attract students' attention.

C. *The Influence of Microlearning-Based* Teaching *Materials on Learner Ecoliteracy*

Experimental research to examine the effect of teaching materials on student ecoliteracy has been conducted at SMA Negeri 1 Belitang for 63 students divided into 3 classes, namely experimental class 1 (using video), experimental class 2 (using podcast), and control class (without special treatment). Based on the results of research and measurements, the average results of pretest, posttest, and N-Gain obtained the ecoliteracy score of students from the three classes as presented in the following diagram.

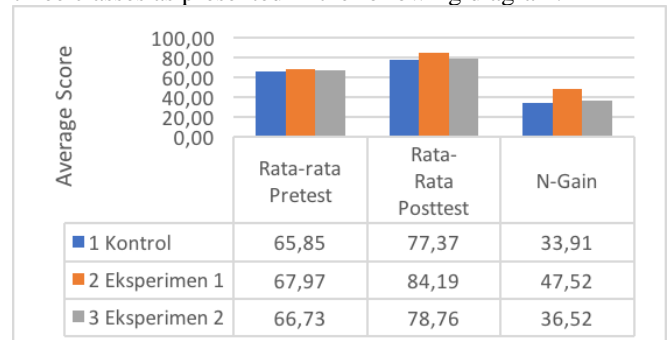|	Rata-rata Pretest	Rata-Rata Posttest	N-Gain
■ 1 Kontrol	65,85	77,37	33,91
■ 2 Eksperimen 1	67,97	84,19	47,52
■ 3 Eksperimen 2	66,73	78,76	36,52

Fig. 2 Comparison of Learner's Average Ecoliteracy Score Acquisition

Based on the diagram, it can be seen that there is no significant difference between the pretest results of the three classes. However, in the value of student ecoliteracy posttest, there are significant differences. Experimental class 1 that uses microlearning-based video teaching materials received the highest average score of 84.19 and the control class received the lowest average score of 77.37. The highest average score of N-Gain was also obtained by experimental class 1, which was 47.52.

There are three hypotheses proposed in this study that need to be proven to determine the effect of microlearning-based teaching materials on the ecoliteracy of students. However, before conducting a hypothesis test using the independent sample T-test, it is necessary to test the normality and homogeneity of the research data. Based on the results of the normality test with Kolmogorov Smirnov

on N-Gain data on the level of ecoliteracy of students, it was concluded that the data of experimental class 1, experimental 2, and control were normally distributed. This can be seen in the following significance value obtainment table which shows a significance value > 0.05.

TABLE IX
NORMALITY TEST RESULT

No.	Class	Sig Value	Description
1	Control	0.176	Normal
2	Experiment 1	0.200	Normal
3	Experiment 2	0.200	Normal

Homogeneity test was carried out on each hypothesis test. Hypothesis test 1 is about "The effect of microlearning-based video teaching materials on the ecoliteracy of students". The data tested were experimental grade 1 N-Gain scores and controls. Based on the results of the homogeneity test shows that the data is homogeneous. This can be seen from the significance value of Levene Static which shows a number of 0.54>0.05. So that the data can be analyzed using the independent sample T-test. Based on the results of the test, it was found that the value of Sig. (2-tailed) was 0.006. When compared to the significance level, it is found that 0.006<0.05. It means Ha is accepted and Ho is rejected. It interprets that "There is an effect of microlearning-based video teaching materials on the ecoliteracy of students".

Hypothesis test 2 is about "The effect of microlearning-based video teaching materials on the ecoliteracy of students". The data tested were experimental grade 1 N-Gain scores and controls. Based on the results of the homogenity test hypothesis 2 shows that the data is homogeneous. This can be seen from the significance value of Levene Static which shows a number of 0.402>0.05. So that the data can be analyzed using the independent sample T-test. Based on the results of the test, it was found that the value of Sig. (2-tailed) was 0.006. When compared to the significance level, it is found that 0.542<0.05. It means Ha is rejected and Ho is accepted. It interprets that "There is an effect of microlearning-based video teaching materials on the ecoliteracy of students".

Hypothesis 3 test is about "Differences in the use of microlearning-based podcast and video teaching materials on the ecoliteracy of learners." The data tested were experimental grade 1 N-Gain scores and controls. Based on the results of the homogenity test hypothesis 2 shows that the data is homogeneous. This can be seen from the significance value of Levene Static which shows a number of 0.149>0.05. So that the data can be analyzed using the independent sample T-test. Based on the results of the test, it was found that the value of Sig. (2-tailed) was 0.006. When compared to the significance level, it is found that 0.017<0.05. It means Ha is accepted and Ho is rejected. This interpreted that "There are differences in the use of microlearning-based podcast and video teaching materials on the ecoliteracy of students". This means that video teaching materials have higher effectiveness than podcast teaching materials in influencing the ecoliteracy of students.

Based on these results, it can be concluded that microlearning-based video teaching materials have the highest influence and effectiveness in increasing the ecoliteracy of students. These results are in line with the results of various studies that have been done previously which concluded that video media have better effectiveness to teach material about the environment and foster an environmentally conscious attitude (Anantasari et al., 2015; Smithwick et al., 2018). In addition, video media has the advantage of visualizing objects that are difficult for students to imagine and reach only in a short and inexpensive time (Brame, 2016). Visualization of geography learning media can make it easier for students to digest the lesson well (Akhmad et al., 2018).

This advantage can answer the results of research (Booth & Sinker, 1979), which states that one of the difficulties to teach environmental material is because it requires a lot of time, energy, and cost to bring students to observe the environment directly. Therefore, video media can overcome the time, labor, and cost limitations that students have. They can learn about the environment just by viewing videos without having to spend a lot of time, energy, and expense.

Videos combined with the microlearning concept become more effective and efficient due to their short duration and ideal. Each video is only 4-6 minutes long. The duration restriction is based on the assumption that, viewers like short, dense content compared to long, boring content. Short-duration videos (3-10 minutes) have high viewing retention so viewers tend to watch videos to the end compared to videos that are too long because they tend to be boring (Davis & León, 2018; Finkler & Leon, 2019).

Unfortunately, microlearning-based podcast teaching materials do not have a significant influence on increasing the ecoliteracy of learners. The podcast teaching materials do not have a significant influence due to the limitations of the podcast in visualizing the material. The podcast teaching material is not suitable for describing concrete material. However, podcasts are suitable for use as a medium for delivering stories, lectures, speeches, orations, and conceptual material (Bolliger et al., 2010; Hew, 2009). Although there is no significant effect, microlearning-based podcast teaching materials have better effectiveness in teaching ecoliteracy than conventional teaching materials. It can be seen based on the difference in the average score of N-Gain ecoliteracy of students between experimental class 2 (36.52) greater than the control class (33.91).

IV. CONCLUSIONS

Based on the results of the study, it can be concluded that microlearning-based video and podcast teaching materials have a very high validity in terms of material and media. Thus, teaching materials are suitable for wide use. Microlearning-based video and podcast teaching materials also received excellent responses from teachers and students who had used the teaching materials. Microlearning-based video teaching materials have a significant effect on the ecoliteracy of students. Meanwhile, microlearning-based

podcast teaching materials do not have a significant effect on the ecoliteracy of students. Thus, microlearning-based video teaching materials have better effectiveness than microlearning-based podcast teaching materials in influencing the ecoliteracy of students.

This research can still be developed by adding larger research subjects. This research only focuses on developing teaching materials, so the research subjects involved in product trials are limited to one school and 3 classes. Therefore, the future of microlearning-based teaching material products produced in this study can be tested more extensively by involving larger research subjects.

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