Development of Digital Teaching Materials Based on Betawi Local Food to Increase Ecoliteracy in Elementary School Students

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Abstract

Ecoliteracy is an awareness about the importance of saving the environment from potential hazards. Consuming local food is part of ecoliteracy which can be introduced through digital teaching materials. This research aims to produce such materials based on Betawi local food to increase ecoliteracy in elementary school students. The approach used was research and development involving 52 grade IV elementary school students from two different schools in East Jakarta for a small-scaled trial. Product validation was carried out through qualitative descriptive analysis by classifying information from inputs, suggestions, responses, and criticisms acquired from data collection instruments. Quantitative descriptive data was also used to process data obtained through tests and questionnaires in the form of descriptive percentages. Results show that digital teaching materials based on Betawi local food can be implemented in learning and can increase student ecoliteracy effectively in the aspect of head (cognitive). Based on these results, the product is ready to be implemented on a large scale and can be enhanced to increase students' ecoliteracy.

Keywords**: *digital teaching materials, Betawi local food, ecoliteracy.*

Abstrak

Ecoliteracy merupakan kesadaran akan pentingnya melindungi lingkungan dari potensi kerusakan. Mengonsumsi pangan lokal merupakan bagian dari *ecoliteracy* yang dapat diperkenalkan melalui bahan ajar digital. Penelitian ini bertujuan untuk menghasilkan bahan ajar digital berbasis pangan lokal Betawi untuk menumbuhkan *ecoliteracy* siswa sekolah dasar. Pendekatan yang digunakan adalah *research and development* yang melibatkan 52 siswa kelas IV sekolah dasar dari dua sekolah yang berbeda di Jakarta Timur untuk uji skala kecil. Validasi produk dilakukan melalui analisis data deskriptif kualitatif yang dilakukan dengan mengelompokkan informasi berupa masukan, saran, tanggapan, dan kritik yang terdapat dalam instrumen pengumpulan data. Data deskriptif kuantitatif juga dilakukan untuk mengolah data yang diperoleh melalui tes dan angket dalam bentuk persentase deskriptif. Hasil penelitian menunjukkan produk bahan ajar digital berbasis pangan lokal Betawi dapat diimplementasikan dalam pembelajaran dan efektif menumbuhkan *ecoliteracy* siswa pada aspek *head* (kognitif). Berdasarkan hasil tersebut, bahan ajar siap diimplementasikan pada skala besar dan dapat dikembangkan untuk menumbuhkan *ecoliteracy* siswa.

Kata kunci: *bahan ajar digital, pangan lokal Betawi, ecoliteracy.*

INTRODUCTION

An environmentally friendly behavior is related to ecological intelligence (ecoliteracy). Ecoliteracy is a person's ability to adapt to the surrounding environment based on knowledge, awareness, and skills to live in harmony with nature (Goleman, 2010; Rusmana & Akbar, 2017; Supriatna, 2016). The desire to protect the environment can grow along with students' knowledge. Furthermore, awareness will emerge from the knowledge gained by students to take a role in saving the environment from things that can damage it. Ecoliteracy of students can be developed through teaching and learning process which is organized into four aspects: head (cognitive), heart (emotional), hands (active), and spirit (connectedness) (Capra & Luisi, 2014; Muthukrishnan, 2019). The head (cognitive) domain includes critical thinking skills and an ability to imagine long-term impact of actions on the environment. The heart (emotional) domain includes concern, love, respect, and empathy for all beings. The hands (active) domain includes creativity in making tools and actions that support sustainability and energy adjustment.

Students' awareness to consume local food to live a healthy life while preserving the environment is part of ecoliteracy. In fostering ecoliteracy, educational practitioners can reconstruct students' minds to consume a variety of local healthy foods and drinks. For example, students are introduced to Bir Pletok, which is unique in Betawi. Bir Pletok (or Pletok beer) is made of spice extracts. Although ingredients vary in each region, ginger and sappanwood are always present (Ishartani et al., 2012; Muliani, 2017). Other ingredients are cinnamon, lemongrass, cardamom, nutmeg, pepper, basil flowers, and roots. Despite the name, Bir Pletok does not contain alcohol. If consumed, this drink can warm the body, and the spice content is believed to overcome various health problems.

Other healthy foods can be introduced to students in the hope of changing their habits of consuming instant food and unhealthy snacks. In this case, students are introduced to Betawi snacks, such as kerak telor or egg crust. Consuming egg crust is an ecologically smart act compared to consuming instant noodles packaged in plastic wrap. Consuming egg

crust can be based on an understanding of its nutritional content, which is richer than instant noodles.

In this information age, due to the rapid development of information and communications technology (ICT), digital teaching materials are considered very relevant. ICT has been transforming learning paradigms from conventional learning to electronic learning (e-learning), from electronic learning to mobile learning (m-learning), and now they are evolving to ubiquitous learning (u-learning) (AjazMoharkan et al., 2017; Apostolou, 2020; Botturi, 2019; Khan, 2021; Kordaki & Gousiou, 2017; Ozerbas & Erdogan, 2016; Palalas & Wark, 2020). Several researchers stressed that students find it easier to access teaching materials that are packaged in digital format (Fansury et al., 2020; Flórez-Aristizábal et al., 2019; Holzberger et al., 2013; Lara Nieto-Márquez et al., 2020; Robinson et al., 2019). Students can learn from the shared teaching materials from anywhere without having to have them in a hard file. Not only can it be accessed via laptops, but also via smartphones, which almost everyone living in the 21st century has.

Digital teaching materials are increasingly relevant not only because we live in the twenty-first century but also because of the global pandemic. Online learning has been implemented nationally since the occurrence of the Covid-19 pandemic. During the online learning process, many barriers to learning activities were observed, including flawed situation for educators during transfer knowledge (Kusmayanti et al., 2021; Utami & Vioreza, 2021). Therefore, to maximize the learning outcomes, it is necessary to provide digital teaching materials that are easily accessible by students. Portraits from the real world can be presented to students through digital learning. Students do not have to go directly to field to learn, but they can experience it directly through the digital teaching materials provided. Digital teaching materials such as audiovisual and interactive multimedia will be more effective for students. Saripudin et al. (2021) expressed that the most effective learning media and teaching materials used in the current ICT era are interactive multimedia.

Ecoliteracy has been studied previously by several researchers. Muthukrishnan (2019) studied the effect of using picture books on increasing elementary school students' ecoliteracy. The results indicate that the use of picture books about ecosystems can improve students' ecoliteracy. Kim et al. (2017) researched on enhancing ecoliteracy through proverbs related to Korean's Traditional Ecological Knowledge (TEK) and find that TEK-related proverbs can be meaningful to improve ecological knowledge among urban youth. Desfandi et al. (2017) studied on building ecoliteracy through the Adiwiyata Program. This research uses survey techniques to show that there is a positive and significant influence of school policies, curriculum implementation, school culture, and management of school infrastructure to improve student ecoliteracy. Research by Daesusi & Asy'ari (2019) focused on the implementation of ecoliteracy learning designs in Adiwiyata schools. The results show that the application of learning influences students' love for schools in good category.

Unlike previous studies, this work aims to increase students' ecoliteracy by developing digital teaching materials about the importance of consuming local food. To the best of our knowledge, there have been no researchers developed teaching materials containing Betawi local food in print or digital form that can be used by teachers and students in learning activities. This study intends to develop interactive multimedia as digital teaching materials that combine and connect all types of media in text, images, audio, video, and animation. Interactive multimedia is equipped with controls for users to choose the activities they want.

METHODS

This work uses a research and development methodology. The development procedure is a modification of the Borg and Gall development model, which includes preliminary study, planning, product development, product validation, and product testing (Borg & Gall, 1983). Only a small-scaled product trial was reached in this research and not the implementation phase.

In the preliminary study, a literature review was carried out along with requirement analysis and problem identification. A literature review was conducted to study various theoretical foundations which are the basis for development. A literature review was carried out in relation to student ecoliteracy, teaching materials, and Betawi local wisdom. In this phase, interviews with elementary school teachers were conducted to learn about students' ecoliteracy, the availability of teaching materials that present environmental concerns, and local wisdom that is integrated into the learning process.

In the planning stage, questionnaires were distributed to capture the requirements for developing the product. Data from questionnaires were processed, and research instruments were developed. Furthermore, in the product development phase, researchers designed the teaching materials based on requirement analysis results. In the product validation phase, an expedience test was carried out by teaching material experts, media experts, and linguists. Validations by experts are needed to complete the product design before delivering it to users (i.e., students and teachers). They consist of validation statements regarding the teaching materials and the use of language and media. If validation results show that the materials and their presentations are not appropriate, then the researcher will revise it according to the input from these experts. A small-scaled product trial was conducted involving fourth-grade students of Cipayung State Elementary School 02 and 05 Pagi State Elementary School.

In requirement analysis, data were collected from 29 students and 2 teachers. In the validation test, participants include two media experts, three material experts (one education practitioner or teacher, one cultural practitioner, and one doctor from primary education), and two linguists. In the small-scaled field trial, data were collected from 52 fourth-grade elementary school students of Cipayung State Elementary School 02 and 05 Pagi State Elementary School. The purposive sampling method was used to select samples. With this method, samples were selected based on a specific purpose, not based on level or area. Participants were of 9 to 10 years of age. Table 1 presents the details of all participants.

Table 1. Details of participants

Phase	Group	Number of participants
Requirement Analysis	Students	29
	Teachers	2
Validation Test	Media Experts	2
	Material Experts	3
	Linguistic Expert	2
Small-scaled Field Trial	Students	52

In this research, data were collected through interviews, tests, and questionnaires. Interviews were conducted to collect initial data about ecoliteracy of elementary school

students, the availability of teaching materials, and their integrations with local wisdom. Interview guidelines were used as instruments. Tests consist of several questions, each with four alternative answers to measure product effectivity and practicality in a small-scaled trial. More specifically, tests are intended to observe improvements in students' ecoliteracy before and after using the teaching materials. Questionnaires were used to gather data regarding the requirements to develop the teaching materials, product validity, and responses of teachers and students about the use of the teaching materials. Questionnaires were distributed to teachers, students, and experts.

The data collection instrument is an important element because it determines whether the data obtained is good or not. Table 2 presents the assessed aspects, the instruments used, the observed data, and the respondents involved.

Table 2. Details of instruments, observed data, and respondents

Data	Instrument	Observed data	Respondents
Requirements for teaching materials	Interview, questionnaire	The requirements of digital teaching materials based on local wisdom according to teachers and students	Teachers and students
Product validity	Questionnaire (validation sheet)	Content validity Material validity Language validity	Team of experts
Practicality	Questionnaire	Ease of learning for students and teachers using digital teaching materials based on local wisdom	Teachers and students
Effectivity	Test	The effectivity of teaching materials based on local wisdom to increase the ecoliteracy of students in cognitive aspect using digital teaching materials based on Betawi local wisdom	Students

Descriptive analysis is the data analysis technique used in this research. The collected data are classified into two, namely, quantitative data in the form of numbers and qualitative data expressed in words. Quantitative descriptive data analysis was carried out by grouping information from the data in the form of input, suggestions, responses, and criticisms contained in the data collection instrument. This analysis is used as a reference for revising the product. Qualitative data is used to accompany and complement the figures obtained from quantitative data analysis.

Quantitative descriptive data is used to process the data obtained through questionnaires or checklists in the form of descriptive percentages. The questionnaire responses about the requirements from teachers and students produce data in the form of scores stating the preferences of respondents in the provision and development of the teaching materials. These preferences are summarized by calculating the percentage of answers to each question item.

The results of the respondents' data analysis are interpreted into criteria, as presented in Table 3.

Table 3. Criteria for validity

Percentage	Category	Information
75.01%–100.00%	Very valid	Can be used without revision
50.01%–75.00%	Valid	Can be used with minor revisions
25.01%–50.00%	Quite valid	Usable with fixes
00.00%–25.00%	Invalid	Unusable

Source: (Akbar, 2013)

Data regarding the practicality of the teaching materials were obtained from questionnaires given to teachers and students. In the same manner, responses from teachers and students are grouped into criteria shown in Table 4.

Table.4: Practicality criteria

Percentage	Category	Information
75.01%–100.00%	Very practical	Needs no revision
50.01%–75.00%	Practical	Needs minor revision
25.01%–50.00%	Practical enough	Can be used with moderate revision
00.00%–25.00%	Not practical	Needs major revision

Source: (Akbar, 2013)

After the product is revised according to inputs and suggestions from experts, a field trial is carried out on a small scale to measure the effectivity of the product. Students are given treatment using the product to determine their learning outcomes. The results were analyzed by comparing the ecoliteracy of students in head (cognitive) aspect before and after being given treatment. Ecoliteracy indicators for head (cognitive) aspect used in this study are shown in Table 5.

Table. 5: Research Instruments from the Center for Ecoliteracy (2013)

Set of Core Competencies from the Center for Ecoliteracy	Achievement Indicator
Head (Cognitive) ▪ Approach issues and situations from a systems perspective ▪ Understand fundamental ecological principles ▪ Think critically, solve problems creatively, and apply knowledge to new situations ▪ Assess the impacts and ethical effects of human technologies and actions ▪ Envision the long-term consequences of decisions	1. Students can identify various types of local food. 2. Students can identify food ingredients used to make local cuisine. 3. Students can identify unhealthy foods as well as healthy food alternatives. 4. Students can differentiate between healthy and unhealthy foods consumed by them and their families. 5. Students understand the advantages of eating healthy local foods for their health and the environment. 6. Students can explain the environmental and health risks of using synthetic materials. 7. Students can explain why it's important to eat

Set of Core Competencies from the Center for Ecoliteracy	Achievement Indicator
	healthy local food.
	8. Students understand the risks of consuming unhealthy food (i.e., instant food) to their health and the environment.

Based on eight indicators shown above, 25 multiple-choice questions were given to students before and after learning using the product. The results were analyzed with predetermined scoring criteria to learn the differences in the ecoliteracy of students. The analysis was performed using SPSS 28, using paired t-test with a significant level of 5%. The digital teaching materials based on Betawi local food are deemed effective if they can increase students' ecoliteracy.

RESULTS AND DISCUSSION

Product requirements are analyzed based on literature review and rating scale instrument. The results become a reference in developing the teaching materials, which consist of four aspects, (1) local food materials, (2) presentation, (3) language, and (4) graphics.

In the aspect of local food materials, there are six indicators, namely, material properties, material form, material criteria, material scope, material source, and additional menus in the material. Teachers are more likely to want materials with understanding rather than rote. From interviews, teachers do not want rote materials because they will be boring for students. Teachers also tend to want the materials to be applicable in everyday life. They also tend to want materials that consist of topics with explanations because students find it easier to understand materials in this form. In addition, materials in the form of stories are also preferable. According to teachers, materials in the form of stories will be more interesting, and they will avoid boredom from students if packaged interestingly. Moreover, students are presented with materials about current phenomena before entering the core materials about local Betawi food.

According to teachers, the teaching materials presented to students must be simple so that they are easily understood and absorbed more quickly. To foster ecoliteracy in elementary school students, teachers want materials about local Betawi food. In addition, teachers also want materials about healthy food, instant food, and comparisons between instant food and local healthy food through examples. The teaching materials are collected from various sources, including books, the Internet, and folklore about healthy local Betawi food. Teachers also want to include games as an additional menu to increase students' interest in learning. In addition, teachers also want to have a glossary in the materials to define important terms that are new to students. The glossary will help students in understanding the materials. Table 6 presents the teachers' answers for each aspect.

Table 6. Requirement aspects for digital teaching materials about Betawi local food

Indicator	Tendency of answer	Results (%)
Material properties	The material in the form of understanding	80
	Material is applicable	60

Material form	The material in the form of explanations and topics of discussion	80
	The material in the form of stories	60
	The material is the latest phenomenon	60
Material criteria	Material is simple	80
	The material is easy to understand by students	80
Material scope	The material presented includes complete Betawi food, healthy local Betawi snacks, getting to know healthy food, instant food, and its impact on health and the environment	100
Material source	The material comes from various sources	100
Additional menu in the material	Some examples or stories contain cultural values	60
	There is additional information related to the material so that it can add insight	80

Based on the requirement analysis, it is necessary to develop digital teaching materials based on Betawi local food to foster ecoliteracy of elementary school students. In this phase, prototype of this product is developed. The teaching materials are in the form of interactive multimedia packaged into an Android mobile application. The final form of this application can be downloaded from Google Play Store.

Figure 1. Application landing page

Figure 1 shows the landing page of the application. This page contains learning materials that users (i.e., students) can select. The materials consist of four parts, namely, (1) Healthy Foods (Makanan Sehat), (2) Instant Foods (Makanan Instan), (3) Healthy Local Foods of Betawi (Makanan Sehat Lokal Betawi), and (4) Local Foods vs Instant Foods (Makanan Lokal vs Makanan Sehat). These materials are presented in 2D animation, images, texts, and a simple game (quiz), as shown in Figure 2. Test comprehension and glossary follow these four materials. Other menus on the landing page are Info and About. The Info menu contains mandatory information about the description of materials for teachers and students and the objectives of the study.
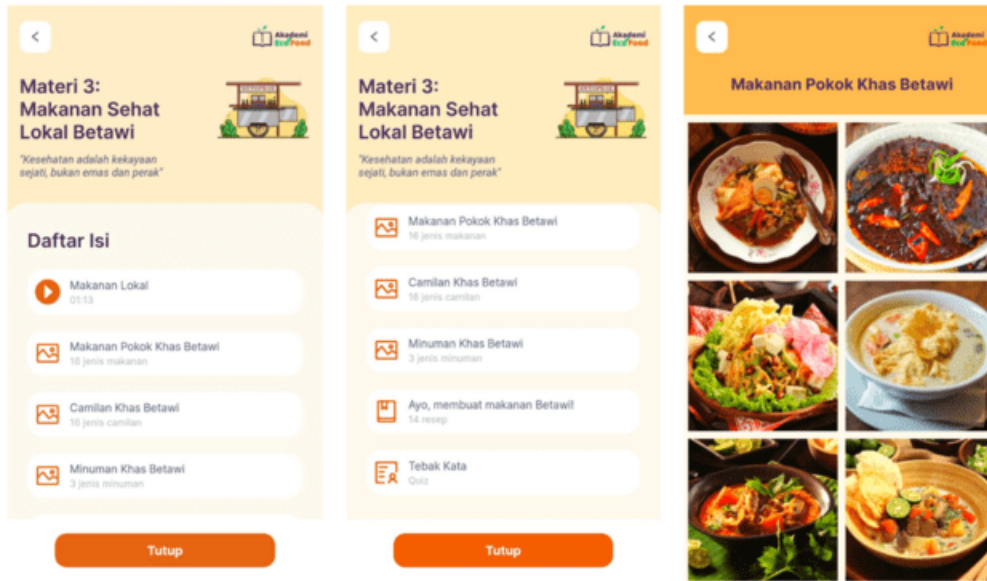
Figure 2. Materials about healthy local Betawi foods (Makanan Sehat Lokal Betawi)

Betawi foods, which are primary foods, snacks, and drinks, are presented in the application with comprehensive explanations so that students can familiarize themselves with them. When an image is tapped, the app will show the food descriptions in the form of texts and images, as shown in Figure 3.

Figure 3. Description of Betawi local food

The teaching materials are complemented with a simple game or a quiz. In each lesson, students can play this quiz with questions related to the subject. The quiz is in the form of a Wordle-style word guessing game, as shown in Figure 4.

Figure 4. Word guessing game in each lesson

The teaching materials also contain evaluations in the form of 15 multiple-choice questions. The evaluation result is shown after each attempt, and the students can verify if their answers are correct or not (Figure 5).
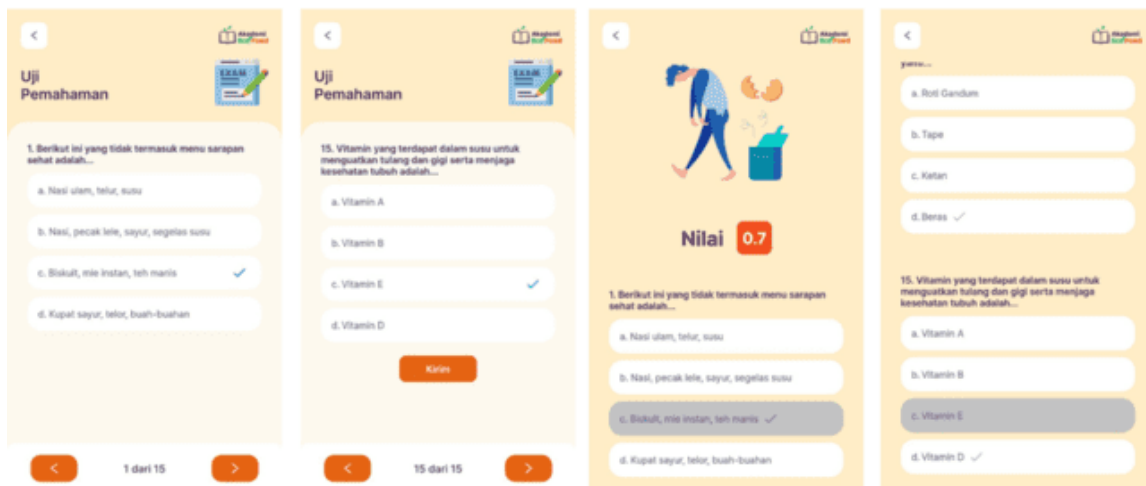

Figure 5. Evaluation "*Uji Pemahaman*"

Before the product is tested by elementary school students, it is validated by a team of experts and practitioners. The validation results are used to revise the components of the materials that are deemed necessary to be improved. Researchers believe that suggestions and input from experts will improve the quality of the teaching materials. These validations are conducted by teaching material experts, media experts, and language experts. Table 7 presents the validation results.

Table 7. Expert validation results

Aspect	Score
Content quality	88.89%
Presentation	88.33%
Language	89.58%
Illustration	87.50%

Ease of navigation	83.33%
Cognition content	93.33%
Information presentation	91.67%
Average	88.94%
Criteria	Very valid

As presented in Table 7, the results of validation obtained a score of 88.94% which is a very valid category. From the validation result, it can be concluded that this product deserves to be continued and used for learning. Furthermore, validation by media experts is used to determine the expedience of the materials, including the use of illustrations, completeness, technical quality, navigation, media integration, artistic and aesthetic, and overall function. Table 8 presents these results.

Table 8. Media expert validation results

Aspect	Score
Use of illustrations	91.67%
Completeness	80.55%
Technical quality	97.22%
Navigation	91.67%
Media integration compatibility	88.33%
Artistic and aesthetic aspects	95.37%
Overall function aspect	90.00 %
Average	90.68%
Criteria	Very valid

As presented in Table 8, the media expert validation test results obtained a score of 90.68% with a very valid category, concluding that the product can be continued and used for learning. Validation tests were also carried out by linguists, as presented in Table 9.

Table 9. Linguist expert validation results

Aspect	Score
Straightforwardness	91.67%
Communicative	100%
Interactive dialogue	93.75%
Conformity with student's development	81.25%
Conformity of language rules	93.75%
Use of the term symbol or icon	87.50%
Average	91.32%
Criteria	Very valid

As presented in Table 9, linguist validation results achieved a score of 91.32% with a very valid category. Overall validation test results show that the product of digital teaching materials based on Betawi local food is worthy to be continued and used for learning.

Small-scaled field trials also included practicality tests by distributing questionnaires, which include eight assessment aspects. Responses were acquired from 2 teachers and 52 students. Table 10 presents teachers' and students' responses.

Table 10. Teachers' and students' responses for practicality

Aspect	Score (Teachers)	Score (Students)
Look and feel	92.50%	90.50%
Material presentation	95.00%	95.00%
Usefulness	97.50%	97.50%
Ease of navigation	95.00%	95.00%
Cognitive content	97.22%	95.22%
Information presentation	93.75%	93.75%
Artistic and aesthetic	95.83%	91.32%
Whole functions	93.75%	93.75%
Average	95.08%	94.00%
Criteria	Very practical	Very practical

Based on questionnaire responses, it can be concluded that the product is very practical with a score of 95.08% and 94.00% from teachers and students, respectively. Suggestions and feedbacks from teachers are to socialize the teaching materials through Teacher Working Group and other elementary schools.

Effectivity test results were acquired by conducting pretest and posttest. Table 11 presents the comparison of the initial and final test results for effectivity during the field trial.

Table 11. Effectivity test results (based on SPSS 28)

	Mean	Std. Dev.	df	p-value (two-tailed)
Pretest–Posttest	−22,577	10,977	51	<0.001

As presented in Table 11, a significance was obtained with two-tailed p-value < 0.001. This means that there is a difference between before and after treatment because the p-value < 0.05 (with a 95% confidence level). The mean value (−22,577) is negative, which means that there is a tendency to increase the posttest score after treatment. Hence, it can be concluded that this product is effective to increase ecoliteracy of elementary school students.

Fostering ecoliteracy is important because it helps students understand the natural world and the ways in which human actions can impact the environment. It also helps students understand the importance of protecting the environment and promoting sustainability.

Lewis-Pierre and Aziza (2017) state that digital teaching materials facilitate learning as effective and interactive learning resources. Fiorella and Mayer (2018) stressed that teachers can achieve learning goals by facilitating students with learning instruments. The learning process is an attempt to change students' behavior (Göksu et al., 2017). Changes in behavior can occur due to the interaction between students and their environments.

The rapid development of ICT makes students digital natives. They are accustomed to using digital devices because a lot of their time is spent with technology or digital devices. Vioreza et al. (2022) stated that students who are digital natives have characteristics of being cognitively accustomed to jumping from one subject to another. They can perform several activities at the same time, such as listening to music while reading, and still being able to understand what they read. With these characteristics, students will find it easier to learn using technology. They will be interested in learning with teaching materials that can be

accessed using digital devices such as smartphones. Digital teaching materials contain multimedia content in presenting the subject matter to be more interesting, thus creating fun learning (joyful learning). In addition, the use of digital teaching materials can also make learning more effective in achieving optimal learning objectives.

CONCLUSION

Digital teaching materials about Betawi local food have proven to be practical and effective in increasing elementary school students' ecoliteracy in the head (cognitive) aspect. This product is considered interesting and fun since it contains teaching materials that are presented in easy-to-read text, audio, and animations with interesting characters. The product is deployed as an Android application that users (i.e., teachers and students) can access easily. The use of technology such as smartphones is not something foreign to students who are digital natives. Presenting digital teaching materials in the form of interactive multimedia leaves a lasting impression on students' minds, and local food contents make learning objectives can be achieved effectively since it relates to student's lives. Education practitioners are recommended to develop digital teaching materials with a clear development procedure, and by observing student characteristics in learning, so that the learning materials can yield optimal benefits in achieving learning goals.

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