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Development of an Environment-Based Video Tutorial on Making Eco-Enzymes from Household Food Waste

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ABSTRACT

Household organic waste is the largest component of national waste generation that has not been managed optimally, thus potentially causing environmental and health problems. In RW 03, Gangsiran Ledhok Hamlet, Batu City, education on the use of organic waste to make eco-enzymes is still limited and not supported by easily accessible audiovisual media. This study aims to develop a tutorial video for making household eco- enzymes as an educational medium for organic waste management. The study used the Research and Development (R&D) method with the ADDIE model which includes the stages of Analysis, Design, Development, Implementation, and Evaluation. The research subjects consisted of 50 housewives, including 10 respondents for needs analysis, 10 respondents for small group trials, and 30 respondents for large group trials. The validation results showed an assessment by material experts of 95% and media experts of 80.92% with a very feasible category. The small group trial obtained a score of 85.63% and the large group 87.85%, both of which are in the very feasible category. The conclusion of the study shows that the tutorial video for making household eco-enzymes is very suitable for use as an educational medium for household organic waste management.

Keywords
ADDIE Model
Eco-Enzyme
Household Organic Waste
Video-Based Education
Waste Management

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Introduction

Organic food waste from households constitutes the largest portion of waste in landfills across various regions of Indonesia, yet it has not been a primary focus of waste management systems [1]. The majority of organic waste generated by household activities is generally not utilized optimally, as it is often disposed of directly without undergoing any treatment process [2]. This situation is influenced by low levels of public knowledge, attitudes, and participation in household waste management [3]. Yet, if managed properly, organic food waste can become a useful resource for human life [4]. Population growth, accompanied by increased community activities and consumption patterns without being balanced by efforts to process food waste has led to an increase in waste generation, placing significant pressure on landfills [5]. This situation highlights the need for simple methods of managing organic waste that are easy for the community to implement. One method of food waste management involves the production of brown liquid eco-enzymes, which are obtained through the fermentation of vegetable scraps and fresh fruit peels mixed with sugar and water and offer various benefits [5]. In addition to helping reduce household waste, eco-enzymes can also be used as natural cleaners, fertilizers, and pesticides, and they support environmental cleanliness and public health [6].

Accumulations of food waste that are not properly managed have the potential to disrupt environmental balance and public health [7]. Decaying organic waste can become a breeding ground for mosquitoes, rats, and other disease-carrying animals [8]. These vectors can transmit various diseases such as parasitic worm infections, diarrhea, dysentery, malaria, dengue fever, and filariasis [9]. Piles of organic waste can also pose a risk of environmental damage. The decomposition of organic waste has the potential to release methane gas, which is a greenhouse gas and contributes to global climate change [10]. Leachate a toxic substance formed through chemical and biochemical processes in organic waste piles at landfill sites can contaminate the soil and water surrounding the landfill [11]. Environmental contamination resulting from waste accumulation has the potential to increase the incidence of various non-degenerative, environment-related diseases among the population. This issue highlights that organic waste management is a national concern requiring sustainable solutions to mitigate the risk of environment-related diseases and safeguard public health [12].

Data from the National Waste Management Information System (SIPSN) shows that the amount of waste generated in Indonesia is around 37 million metric tons annually, with household food waste being the largest contributor to the waste composition. Of this total waste volume, national waste management consists of 13% waste reduction, 46% waste management, and 40.9% waste that is not managed optimally [13]. East Java is the second-largest contributor to waste in Indonesia. The potential waste volume reached 6.1 million metric tons in 2023 [12]. The city of Batu, known as a tourist destination, is facing serious

environmental problems related to increasing waste generation. Over the past three years, the volume of waste has continued to rise. Total waste volume in 2022 reached 49 thousand metric tons, then increased to 52 thousand metric tons in 2023, and continued to rise to 52.9 thousand metric tons in 2024. In terms of composition from 2018 to 2024, waste was dominated by organic food waste, averaging 55.26%, and almost all of it came from households [13].

The results of a preliminary study conducted through interviews with environmental extension officers at the Batu City Environmental Agency (DLH) indicate that the Tlekung Landfill has reached maximum capacity and is no longer accessible to the public. The Batu City Government has shifted to a waste management system using TPS3R facilities and has conducted outreach and training on independent waste management including the production of eco-enzymes for PKK women's group members in all villages and neighborhoods. However, the educational activities that have been carried out have not yet reached all residents of Batu City. The chairperson of the Batu City eco-enzyme community stated that Gangsiran Ledhok Hamlet, RW 03, is one of the areas that has never received information or training on converting organic waste into eco-enzymes. The majority of Gangsiran Hamlet residents are homemakers, farmers, and livestock farmers, who actually have great potential to utilize eco-enzymes in their daily activities. Given that organic waste primarily stems from household activities, women particularly mothers play a crucial role in sorting and processing waste at the source [14]. Housewives are the ones who directly handle kitchen waste which consists of food scraps, fruit peels, and vegetable scraps and thus play a crucial role in the implementation of organic waste management at the household level [15]. The active involvement of homemakers in managing organic waste can support the adoption of better waste management practices, starting within the family environment [16].

One strategy to increase community participation in organic waste management can be achieved through health promotion using various educational media [17]. Media widely used in organic waste management education include print and audiovisual media. Print media used in organic waste management education include posters, modules, pocket guides, brochures, leaflets, banners, and infographics. Print media has limitations in the information dissemination process, as it requires printing, involves relatively higher production costs, presents information in a static format, and is less capable of displaying practical steps in detail because it relies solely on text and images [18]. Education on organic waste management has also utilized audiovisual media such as profile videos, social campaign videos, and 3D animated videos. Audiovisual media are more effective at conveying information because they combine visual and auditory elements, making it easier for the target audience to understand the material through sight and hearing [19]. The audiovisual media developed for organic waste management education have several limitations. Profile videos involve a production process

that takes a considerable amount of time and carry the risk of the message missing its mark if not tailored to the audience's characteristics [20]. Social campaign media require regular content updates to remain relevant to current trends and the needs of the target audience [21]. 3D animated videos are limited by their reliance on audio quality and the need for animated elements to be produced in a series, be short in duration, and follow current media trends to maintain the audience's attention [22]. These limitations of various audiovisual media led to the selection of tutorial videos as the medium to be developed. Tutorial videos have an advantage over other audiovisual media because they can present the steps or stages of a process clearly, coherently, engagingly, and in a way that is easily understood by the target audience [23]. This is supported by research which explains that the use of video tutorials on making eco-enzymes in community service activities can increase participants' knowledge and awareness of the importance of organic waste management and encourage them to independently practice making eco-enzymes as one method of organic waste management [24].

Educational efforts on organic waste management through video tutorials align with the concept of community empowerment in health promotion, which aims to enhance the community's ability to maintain and improve their health independently [25]. Furthermore, a media needs analysis was conducted to determine the characteristics of health education media designed based on the target audience's needs. The media needs analysis was carried out by having respondents directly complete a questionnaire. The results of the media needs analysis showed that 60% of respondents had never received education on household waste management. Furthermore, all respondents expressed interest in receiving education through audiovisual media. Specifically, 90% of respondents preferred audiovisual media in the form of video tutorials covering the processing of organic waste into useful products such as eco-enzymes. Additionally, 60% of respondents chose a WhatsApp group as the platform for sharing the videos to ensure easy access for the community. Considering the issues mentioned above, this study aims to develop a video tutorial on making eco-enzymes using the Research and Development (R&D) method, tailored to the needs of the target audience, as an effort to improve and supplement existing educational materials. In the next phase, the developed tutorial will undergo a feasibility test involving experts and users an approach that has rarely been employed in previous studies. The novelty of this study lies in the development of a video tutorial that not only demonstrates the steps for making eco-enzymes but also compares the use of two different types of containers, provides examples of ingredient measurements for various container sizes, explains the benefits of eco-enzymes in daily life, and employs multi-angle filming techniques to clarify the details of the production process. This article consists of four main sections. The first section explains the background and urgency of the study. The

second section describes the research method using the ADDIE development model. The third section presents the development process and feasibility testing results. The final section contains conclusions, limitations, and recommendations for future studies.

Material and Methods

The approach used in this study is Research and Development (R&D), which focuses on the development and refinement of existing products through planned stages [26]. The development of these video tutorials employs the ADDIE model, which includes the stages of Analysis, Design, Development, Implementation, and Evaluation. This model was used because it features systematic, simple, and flexible stages, and provides opportunities for ongoing evaluation at each stage [27]. The population in this study consists of homemakers residing in Gangsiran Ledhok Hamlet, RW 03. Sampling was conducted using purposive sampling, taking into account the inclusion criteria: housewives who actively manage kitchen waste, are willing to participate in the pilot study, and have a permanent residence in RW 03. The sample size consisted of 50 respondents, comprising 10 respondents for the needs analysis phase, 10 respondents for the small-group pilot study, and 30 respondents for the large-group pilot study. Each stage of the research involved different respondents to avoid assessment bias. The determination of the sample size was based on Arikunto (2013), who explains that pilot studies are conducted in two stages: an initial stage involving a small group of 4–14 respondents, followed by a larger group of 15–50 respondents [28]. This study has received ethical approval from the Research Ethics Committee (KEP) of Malang State University (UM) with registration number 20.02.10/UN32.14.2.8/LT2032.

The data collection instruments used included a needs analysis questionnaire, a subject matter expert validation questionnaire, a media expert validation questionnaire, and a media feasibility test questionnaire. The needs analysis questionnaire was used to identify the characteristics of the target audience, their prior educational experience regarding organic waste management, their information needs, and their preferences regarding the educational media to be developed. The subject matter expert validation questionnaire was used to assess the appropriateness of the content, the accuracy of the material, the completeness of the information, and the clarity of the message delivery in the media. The media expert validation questionnaire was used to assess the media's appearance, visual design, audiovisual quality, readability, and ease of use. Meanwhile, the small-group and large-group pilot test questionnaires were used to assess the media's feasibility based on content, appearance, language, and ease of understanding from the users' perspective. The results of the feasibility assessment by subject matter experts, media experts, and focus groups were used to evaluate the quality of the media and served as the basis for product improvements at each stage of development. The media feasibility assessment used a four-point Likert scale consisting of

Very Appropriate (SS), Appropriate (S), Inappropriate (TS), and Very Inappropriate (STS). Each category is assigned a score from 4 to 1, so that a higher score indicates a better level of media suitability. The distribution of assessment scores is presented in the following table.

Table 1. Likert scale assessment

Alternative Answers	Score
Very Appropriate (VA	4
Appropriate (A)	3
Inappropriate (IA)	2
Very Inappropriate (VIA)	1

The next step after the assessment is to calculate the media suitability percentage based on Arikunto's (2013) theory, as follows.

$$P = \frac{f}{n} \text{ x } 100\% \quad (1)$$

Where:
P: Assessment percentage
F: Score obtained
N: Total score

After calculating the final score, the result is used to determine whether the developed media is suitable for use. The assessment criteria are presented as follows.

Table 2. Media feasibility criteria

Alternative Answers	Score
76% < skor ≤ 100%	Highly suitable for use
51% < skor ≤ 75%	Suitable for use with minor revisions
26% < skor ≤ 50%	Fairly suitable for use with major revisions
0% < skor ≤ 25%	Not suitable for use

Results and Discussions

The purpose of this study is to develop a video tutorial as a learning medium for making eco-enzymes and to assess its suitability for use by the community. The suitability assessment was conducted to determine whether the developed medium is ready for widespread use or still needs refinement. The development process followed a Research and Development (R&D) approach using the ADDIE model, which consists of the following systematic stages.

A. Analysis

The analysis conducted in the initial stage of the study aimed to identify potential issues and media needs among the target group. Results from structured interviews with the Head of RW 03 in Gangsiran Ledhok Hamlet and the Chair of the Eco-Enzyme Community indicated that the majority of housewives had not received education on utilizing household organic waste through eco-enzyme production, and that no educational media easily accessible to residents was currently available. Media needs analysis was conducted by distributing a questionnaire to 10 homemakers in RW 03, Gangsiran Ledhok Hamlet. The questionnaire

consisted of 14 closed-ended questions covering aspects of educational experience in waste management, media previously used, information needs, and community preferences regarding the video media to be developed. The results of the analysis showed that 100% of respondents were interested in audiovisual media, and 90% of them wanted tutorial videos on converting organic waste into eco-enzymes. A total of 80% of respondents chose college students and the eco-enzyme community as talent, and 50% of respondents preferred a video duration of about 5–8 minutes. The majority of respondents (80%) hoped the material would be presented concisely, succinctly, and clearly, while 100% of respondents chose the horizontal landscape video format. Additionally, 60% of respondents chose a WhatsApp Group as the platform for uploading videos to make them easily accessible to the public. This is supported by the large number of WhatsApp users from various backgrounds as well as the ease of sharing various types of media—such as text, images, audio, and video—making it a viable alternative for disseminating health information [29]. Finally, 70% of respondents indicated a need for subtitles, with 60% of them preferring the SofiaPro font. Subtitles serve as supplementary text to assist individuals with physical or language limitations, enabling them to better understand the video content [30].

B. Design

This section outlines the design, structure, and flow of the video tutorial on making eco-enzymes, tailored to the target audience's needs. At this stage, the content is developed to cover the definition of eco-enzymes, tools and materials, measurement formulas, production steps, differences in treatment methods, and their applications. The design phase also includes the selection of visual elements tailored to the landscape video format, planning for software and supporting media, and determining the video format and duration. The video is designed in MP4 format with a duration of 5–8 minutes. This duration was chosen based on the ideal length for educational videos 5–10 minutes to ensure it is easily understood by users [31]. It also includes the development of a questionnaire for expert validation and focus group testing to evaluate the media's feasibility. At the end of the design phase, a storyboard is created as a key guideline for video production, as it systematically outlines the sequence of scenes and includes camera angles, duration, narration, and transitions to ensure a more focused production process [32]. The storyboard can be accessed via the following link: https://bit.ly/StoryBoardVideoTutorialPembuatanEco enzyme.

The product to be developed is expected to have specifications based on the results of the media needs analysis, which include the following:

- The media will consist of a video tutorial on making eco enzyme
- The participants in the video will be college students and mambers of the eco enzyme community

- The video duration is 5-8 minuts
- The information in the video is brief,concise, and clear
- The video aspect ratio is landscape/horizontal
- The video includes subtitles
- The font used in the video is Sofia Pro
- The video will be uploaded to a WhatsApp group

C. Development

The development phase involved producing a video tutorial on making eco-enzymes based on a previously designed storyboard. In this phase, the researcher compiled the video content through an editing process that included adding visual elements relevant to the material, translating the text, and adding supporting audio. Video editing was performed using CapCut Pro and Canva Pro to produce visuals consistent with the educational content [33]. Once the tutorial videos were completed, the next step involved expert validation of the media and content, followed by a revision process. This process aimed to evaluate the accuracy of the content, the appropriateness of the media presentation, and the suitability of the language used [34]. The assessment is conducted through a validation questionnaire that was developed during the design phase.



Fig. 1. Media display

1. Validation by subject matter experts and media experts

The subject matter validation involved two validators a Public Health faculty member specializing in Environmental Health and a member of the Batu City eco-enzyme community. The assessment was conducted using a questionnaire consisting of 10 items, evaluating the video content, presentation quality, and language quality. The results of the media evaluation by the expert validators are shown in the following table.

Table 3. Results of subject matter expert validation

No	Initials	Organization	Score	Category
1	MA-I	Malang State University	95.00	Highly suitable for use
2	WW	Eco Enzyme Community	95.00	Highly suitable for use
		Total	**95.00**	**Highly suitable for use**

Source: Primary Data, 2026

The material validation results achieved a score of 95%, indicating that it is highly suitable for use. The assessment results show that the presentation of the material supports the achievement of learning objectives, contains accurate information, and is systematically organized in accordance with the characteristics of the target audience [35]. The subject-matter expert validator recommended adjusting the size of additional illustrations to enhance visual clarity in the presentation of the material. Visual clarity in audiovisual learning media plays a crucial role in helping to improve understanding and capture users' attention, particularly in video-based educational materials [36].

The media validation process involved two experts: a public health lecturer specializing in Health Promotion and Behavioral Science, and a member of the Batu City eco-enzyme community. There were 19 evaluation items covering aspects such as video quality, video design, content illustrations, content design, video content quality, and linguistic quality. The results of the evaluation by the media experts are presented in the following table.

Table 4. Media expert validation results

No	Initials	Organization	Score	Category
1	WCR	Malang State University	75.00	Suitable for use with minor revisions
2	WW	Eco Enzyme Community	86.84	Highly suitable for use
		Total	**80.92**	**Highly suitable for use**

Source: Primary Data, 2026

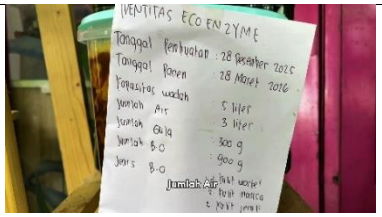
The media validation results show that the first validator assigned a score of 75%, categorizing the media as "acceptable with minor revisions," while the second validator assigned a score of 86.84%, categorizing it as "highly acceptable." A score of 75% indicates that the developed media still requires some refinement, particularly regarding the narrator's voice quality, the consistency of text movement, the layout, and the inclusion of supporting illustrations to make the information presented clearer and more engaging. The overall media validation test yielded an average score of 80.9%, placing it in the "highly suitable for use" category. This score indicates that the developed media has met the key aspects of video media evaluation, including video quality, video design, content illustrations, and linguistic quality [34]. It was accompanied by several suggestions for improving the media, such as adding captions and supplementary illustrations to certain parts of the video. The additional images or illustrations shown were found to make it

easier for participants to visualize the explanations presented compared to if all the information had been presented solely in written form [37].

2. Results of the Review by Content and Media Experts

The evaluation results from the media and content experts indicate that the "Making Eco-Enzymes" tutorial video is considered highly suitable for use, with a number of minor suggested improvements. The media revision process was carried out based on the suggestions and feedback from the validators as an initial step before proceeding to testing with the target users, which is summarized as follows.

Table 5. Results of the expert validation review

Before Revision	After Revision	Description
		The eco-enzyme formula, which originally filled one full page, has been revised to span two pages, and the font size has been increased so that the instructions are more clearly visible.
		Instructions on how to obtain molasses and other types of sugar that can be used have been added.
		Illustrations of the eco-enzyme ingredients have been added so that the ingredients used can be seen in detail and clearly.

Source: Primary Data, 2026

D. Implementation

The implementation phase includes testing the media on a small group after it has been deemed suitable by experts. During the small-group trial, the media will be displayed via a projector so that all participants can clearly and thoroughly view the video content. The small-group trial will involve 10 housewives from RW 03, Gangsiran Ledhok Hamlet, who will provide feedback through a 12 item questionnaire assessing the suitability of the media and its content.

Table 6. Results of large-group trials

No	Indicator	Percentage	Category
Video Media Tutorials			
1	Image quality in the video is good	85%	Highly suitable for use
2	Audio/narration in the video is clear	85%	Highly suitable for use

No	Indicator	Percentage	Category
3	Text in the video uses a combination of easy-to-read fonts	85%	Highly suitable for use
4	Illustrations/images are used in accordance with the material	87.5%	Highly suitable for use
5	Video duration is appropriate	87.5%	Highly suitable for use
Video Content			
6	The material is easy	85%	Highly suitable for use
7	The steps for making eco-enzymes are explained in a logical sequence	80%	Highly suitable for use
8	Information on the benefits of eco-enzymes is clear	82.5%	Highly suitable for use
9	The sentences used in the tutorial video follow the rules of proper and correct Indonesian	87.5%	Highly suitable for use
10	The language used in the video tutorial is simple, straightforward, and easy to understand for the target audience	87.5%	Highly suitable for use
11	The sentences used are consistent with the images presented	87.5%	Highly suitable for use
12	The sentences used are appropriate for the target age group	87.5%	Highly suitable for use
	Average percentage	**85.63%**	**Highly suitable for use**

Source: Primary Data, 2026

The results of the small-group pilot test showed a score of 85.63%, indicating that this medium is highly suitable for use. The evaluation results indicate that the medium meets the criteria for content suitability, clarity of material presentation, visual quality, and ease of understanding by the target audience [38]. Participants stated that the material was presented coherently using clear language, making it easier for the audience to understand the video's content. Some respondents offered suggestions regarding technical aspects, specifically the need to adjust the narrator's volume to ensure consistency throughout each section of the video. The audio element plays a crucial role in helping participants understand and grasp information more clearly, making it a key advantage of audiovisual media over traditional media that rely solely on visual presentation [37]. The media was deemed suitable for use, taking these improvements into account.

After revisions based on the small-group pilot test, the media was then tested on a large group as the final evaluation stage to assess its suitability. The large-group pilot test involved 30 housewives from RW 03, Gangsiran Ledhok Hamlet, who were asked to provide feedback using the same media and material suitability questionnaire as before. This evaluation was summative in nature, aimed at assessing the final quality of the media that had undergone expert validation and initial implementation testing.

Table 7. Results of small group trials

No	Indicator	Percentage	Category
Video Media Tutorials			
1	Image quality in the video is good	90%	Highly suitable for use
2	Audio/narration in the video is clear	88%	Highly suitable for use

No	Indicator	Percentage	Category
3	Text in the video uses a combination of easy-to- read fonts	91%	Highly suitable for use
4	Illustrations/images are used in accordance with the material	89%	Highly suitable for use
5	Video duration is appropriate	85%	Highly suitable for use
Video Content			
6	The material is easy	87%	Highly suitable for use
7	The steps for making eco enzymes are explained in a logical sequence	87,5%	Highly suitable for use
8	Information on the benefits of eco-enzymes is clear	88%	Highly suitable for use
9	The sentences used in the tutorial video follow the rules of proper and correct Indonesian	87%	Highly suitable for use
10	The language used in the video tutorial is simple, straightforward, and easy to understand for the target audience	87.5%	Highly suitable for use
11	The sentences used are consistent with the images presented	88%	Highly suitable for use
12	The sentences used are appropriate for the target age group	86%	Highly suitable for use
	Average percentage	**87.85%**	**Highly suitable for use**

Source: Primary Data, 2026

The results of the evaluation through a large-group pilot test showed that the video tutorial on making eco-enzymes had a feasibility rate of 87.85%, which falls into the "highly feasible" category. The evaluation results indicate that the media meets the feasibility criteria for use in community education activities [39]. This feasibility rate and the positive responses confirm that the media is suitable for use as an educational tool for organic waste management in the community. After the media was deemed suitable by the large group, the final step was to upload the tutorial videos to a WhatsApp group in accordance with the results of the media needs analysis conducted by the respondents. The media was also published on YouTube because it ranked second among the respondents' preferences in the needs analysis and can reach a wider audience. The following links can be used to access the videos that have been developed:https://bit.ly/VideoTutorialPembuatanEcoenzyme & https://youtu.be/f0iqOo-xZbw?si=D5GizYXXj-uX5Yto.

E. Evaluation

The evaluation phase was conducted to review the final results of the educational materials that had been developed. The results of the large-group pilot test showed that there were no revisions, suggestions, or feedback regarding the developed materials. Respondents provided positive impressions and feedback; among other things, the materials were deemed helpful in providing information on processing organic waste into eco-enzyme products and in enhancing housewives' understanding of more beneficial alternatives for managing organic waste. The media had been refined based on validators' feedback from the previous stage, such

as adjustments to the narrator's voice quality, illustration size, and the addition of supporting illustrations and captions to make the media easier for the target audience to understand. A limitation of the media in this study was that the pilot test was still conducted using a projector in a group setting and had not yet measured the media's effectiveness in changing housewives' knowledge, attitudes, or behaviors. The video was uploaded to a WhatsApp group with 50 members and to YouTube, reaching 80 viewers as part of the dissemination of this educational media on organic waste management.

Conclusion

The research findings indicate that the video tutorial on processing organic waste from food scraps into eco-enzymes was developed in accordance with the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The resulting media consists of a tutorial video on making eco-enzymes featuring student talent and members of the eco-enzyme community; it is 5–8 minutes long, contains concise, succinct, and clear information, uses a landscape/horizontal orientation, includes subtitles, uses the Sofia Pro font, and is published via a WhatsApp group to ensure easy access by the target audience. The feasibility test results indicate that the tutorial video is highly suitable for use as a promotional medium for organic waste processing among housewives in Gangsiran Ledhok Hamlet, RW 03. The media was assessed as meeting the criteria for content, presentation, language, and ease of understanding for the target audience, thereby having the potential to enhance housewives' understanding of managing organic waste into useful products. The developed media a video tutorial on making eco-enzymes can support health promotion and community empowerment efforts in household organic waste management by conveying practical and easy-to-understand information. A strength of this study is the use of the ADDIE model, which features systematic, straightforward stages and allows for revisions at every stage of media development, resulting in a product that meets the target audience's needs.

Limitation and Suggestions

Some limitations of this study include the fact that it only reached the stage of testing the media's feasibility and thus has not yet measured the media's effectiveness in increasing knowledge or changing the behavior of the target audience. The study was conducted at a single location, namely RW 03 in Gangsiran Ledhok Hamlet, with the media trial using a projector; therefore, the results cannot yet represent the entire Batu City area or reflect independent media use via the target participants' own cell phones. A recommendation for future researchers is to test the effectiveness of the "Eco-Enzyme Production" tutorial video in improving the community's knowledge, attitudes, and behaviors regarding household organic waste management. Experimental research on the composition of the produced eco-enzymes

also needs to be conducted to scientifically determine their quality and benefits. Based on the findings of this study, it is hoped that the community of RW 03, Gangsiran Ledhok Hamlet, will be able to utilize eco-enzymes not only for household needs but also develop them into economically valuable products that can increase their income. In addition, TPS3R staff, together with the eco-enzyme community and the Batu City Department of the Environment, are advised to actively and regularly organize training on organic waste management using the eco-enzyme production tutorial video as training material for the PKK (Family Welfare Movement), TPS3R educational materials, or WhatsApp-based outreach content.

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Conflict of Interest

The authors declare no conflict of interest.

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