Original Article

Effectiveness Of Health Education Through Video And Leaflets On Knowledge And Waste Sorting Behavior Among Elementary School Students: A Quasi-Experimental Study

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ABSTRACT

Background: Waste sorting has not been widely understood or implemented among elementary school students, resulting in poor waste management in the school environment. However, evidence comparing the effectiveness of video-based versus leaflet-based health education interventions in elementary school settings remains limited. This study aimed to determine the effectiveness of health education on waste sorting on students' knowledge and behavior in State Elementary Schools.

Methods: This quantitative study employed a quasi-experimental two-group pretest–posttest design with no control group, following the TREND reporting guidelines. The sample comprised 60 grade V students (30 from SDN Panggung Rawi and 30 from SDN Sukmajaya 1), selected through a total sampling method. Inclusion criteria were active enrollment as grade V students, ability to read and write, and provision of parental consent, while absent students were excluded at the time of data collection. SDN stands for Sekolah Dasar Negeri, which means State Elementary School (public primary school) in Indonesia. Data were collected using a 16-item, expert-validated questionnaire and tested for reliability (Cronbach's alpha = 0.82 for knowledge and 0.79 for behavior). Univariate analysis used median values, while bivariate analysis applied paired t-tests/Wilcoxon signed-rank tests and independent t-tests/Mann–Whitney U tests, with effect sizes reported as Cohen's d.

Results: At $\alpha = 0.05$, there was a significant difference in knowledge between the video and leaflet groups ($p = 0.012$; Cohen's $d = 0.54$, medium effect). Similarly, there was a significant difference in behavior change between the video and leaflet groups ($p = 0.001$; Cohen's $d = 0.71$, large effect). No participants dropped out, and complete data were obtained from all respondents..

Conclusion: Health education through videos was more effective than leaflets in improving elementary school students' knowledge and behavior regarding waste sorting. Waste sorting interventions can be effectively integrated into school-based waste management programs.

Keywords: Health Education; Waste Management; Students; Audiovisual Aids; Pamphlets.

Implications for Practice:

- Integration of Multimodal Education: Health educators, teachers, and school nurses can enhance students' knowledge and behavior by combining audiovisual (video) and printed (leaflet) media in school-based health promotion programs, providing more engaging and compelling learning experiences.
- Early Development of Environmental Health Literacy: Implementing structured, age-appropriate educational interventions in schools can foster sustainable waste management behaviors among children,

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Implications for Practice:

contributing to long-term improvements in community health and environmental outcomes.

- Applicability in Low-Resource Settings: The study demonstrates that effective health education can be delivered even in schools with limited resources. This makes the approach feasible and adaptable for low- and middle-income countries with restricted access to sophisticated educational tools.

Introduction

The joint report with the International Solid Waste Association (ISWA) highlights the escalating challenge of global waste, projecting municipal solid waste to rise from 2.1 billion tonnes in 2023 to 3.8 billion tonnes by 2050. It warns that the annual costs of poor waste management, including health, pollution, and climate impacts, could nearly double from USD 361 billion in 2020 to over USD 640 billion by mid-century if current practices continue. The report uses life cycle assessments to compare scenarios ranging from business-as-usual to full adoption of zero waste and circular economy strategies. Findings show that stronger waste prevention and management could reduce net costs to USD 270.2 billion, while a fully circular economy could even generate an annual net gain of USD 108.5 billion. To achieve this, the report urges immediate action from governments, industries, financial institutions, and citizens to treat waste as a valuable resource and prioritize sustainable practices (UNEP, 2024).

Waste management issues are a serious challenge in many countries, including Indonesia. Rapid population growth and industrialization cause the volume of waste to increase sharply every year. Indonesia is estimated to produce around 175,000 tons of waste per day or the equivalent of 66.1 million tons per year, but more than half of the people still handle waste poorly (Ministry of Health of the Republic of Indonesia, 2018; (Ratnasari et al., 2019). This condition shows the need for sustainable interventions to increase public awareness and behavior in waste management.

The educational environment is one of the significant sources of waste generation. Elementary schools, for example, produce various types of waste, especially organic and inorganic, which if not managed properly can have health and environmental impacts (Anbarsari et al., 2022). From an early age, waste sorting is an important strategy in creating sustainable environmentally friendly behaviors. However, waste sorting practices among elementary school students are still not optimal, even though most schools have provided sorted waste bins (Lestari et al., 2020).

School is a strategic vehicle to instill the values of caring for the environment, because students have the potential to transmit good habits to their families and the surrounding community (Purnami, 2020).Environmental care behavior can begin with simple actions such as managing waste around the school. Conventional practices like collecting and burning waste or transporting it to landfills are not real solutions, as they only shift the problem from one place to another. Instead, the 3R approach (reduce, reuse, recycle) provides a more sustainable foundation for waste management while fostering environmental awareness among children. This can be achieved by raising awareness through engaging learning activities such as waste-related games, encouraging critical thinking about waste issues in their surroundings, and promoting real actions like recycling. Environmental education through proper waste management should be instilled from an early age to build ecological awareness

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and shape a lasting character of environmental responsibility in children (Purnami, 2020).

According to the relationship theory proposed by Notoatmodjo S, (2012) & Green Kreuter (2005), individual behavior develops through a sequential process of knowledge, attitude, and practice (KAP). Knowledge forms the foundation, as adequate information enables individuals to understand the benefits and risks of certain actions. This understanding then shapes attitudes—internal responses such as feelings, beliefs, or tendencies to accept or reject a behavior—which ultimately influence the adoption of specific practices. Based on the KAP model, behavioral change does not occur instantly but progresses through these interconnected stages. In this context, interventions that enhance knowledge through audiovisual media may be more effective in influencing attitudes and subsequent practices than static print media such as leaflets, because audiovisual channels can deliver information more vividly and engage multiple senses, strengthening comprehension and retention.

Several previous studies have shown the effectiveness of health education interventions with various media. For example, health promotion through leaflets has been shown to increase students' knowledge and behavior in waste management (Sariana, 2018), while audiovisual/video media are more effective in influencing behavior change than print media (Fuadi, 2021; Rianti et al., 2020a). However, studies on the comparative effectiveness of leaflet and video media in the context of elementary schools are still limited, especially in urban areas with high rates of waste generation such as Cilegon City.

Jombang District in Cilegon City is a real example of this problem. Data from the Environment Agency (2022) recorded that Cilegon City's waste production reached 243,811 m^3 per year, and elementary schools were one of the main contributors. A preliminary study at SDN Panggung Rawi and SDN Sukmajaya 1 showed that more than 65% of students did not understand the difference between organic and inorganic waste and were not used to sorting even though facilities were available. This condition shows that there is a gap between the availability of facilities and student behavior in waste management.

Waste sorting among elementary school students remains poorly understood and is often practiced through conventional methods such as burning or simply transporting waste to landfills, which do not provide sustainable solutions. However, there is still limited evidence comparing the effectiveness of different health education media particularly videos versus leaflets in shaping students' knowledge and behavior regarding waste sorting in the school setting. Based on this gap, this study was conducted to analyze the effectiveness of health education using leaflet and video media on improving knowledge and changing waste sorting behavior among elementary school students in Jombang District, Cilegon City. The findings are expected to contribute to the development of school-based health education models and provide valuable input for waste management programs in educational environments.

Methods

Study Design

This study used a quantitative approach with a quasi-experimental design of a *two-group pretest–posttest* type without a control group. This design was chosen to measure the effectiveness of health education interventions through two different media, namely videos and leaflets, on students' knowledge and behavior about

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waste sorting. This quasi-experimental study in Indonesia adhered to the TREND guidelines for non-randomized trials. The research was carried out at SDN Panggung Rawi and SDN Sukmajaya 1, Jombang District, Cilegon City, in March–June 2023. Both schools were chosen because they are public schools with a large number of students and are contributors to waste generation in the area.

Participants

The research population consisted of all students enrolled in State Elementary Schools in Jombang District, totaling 6,051 students. The sample was determined using a total sampling technique, including all grade V students from two selected schools, with a total of 60 participants (30 students from SDN Panggung Rawi and 30 students from SDN Sukmajaya 1). Eligibility criteria included being an active grade V student at the selected schools, able to read and write, and willing to participate with parental consent. Students who were absent during data collection were excluded.

The sample size of 60 was considered adequate for detecting meaningful differences between the two intervention groups, based on feasibility, logistical considerations, and reference to similar quasi-experimental school-based studies. The research workflow followed a structured sequence consisting of recruitment, informed consent, pretest, intervention, posttest, and data analysis.

The pretest measured baseline knowledge and behavior regarding waste sorting, followed by the intervention using either audiovisual (video) media or leaflet media, and concluded with a posttest administered one week later using the same questionnaire to assess changes. Data were initially recorded using paper-based forms during classroom sessions and subsequently entered into SPSS for analysis.

To ensure data accuracy, two independent data entry personnel implemented and cross-checked a double-entry system. The research team supervised all data collection activities. Additionally, enumerators received prior training on the research protocol, ethical considerations, and standardized administration of the questionnaire to minimize bias and ensure data reliability. No participants dropped out during the study, and complete data were obtained from all respondents.

Instruments

Primary data were obtained through a structured questionnaire consisting of 16 items designed to measure students' knowledge and behavior regarding waste sorting. The instrument comprised 8 knowledge items and 8 behavior items. Knowledge was assessed using multiple-choice questions scored 1 for a correct answer and 0 for an incorrect answer, while behavior was measured using yes/no questions, with a score of 1 for "yes" and 0 for "no." The questionnaire was self-developed based on the principles of environmental education and previous studies on waste management behavior among students. Example items include: "Which of the following materials can be recycled?" (knowledge domain) and "Do you separate organic and inorganic waste at school?" (behavior domain). The full questionnaire is provided in the Appendix (Supplementary Material). To ensure validity and reliability, the instrument underwent content validation by two public health experts and one environmental education specialist. As the questionnaire was self-developed and administered in Bahasa Indonesia, no forward–backward translation process was required. Construct validity was evaluated through a pilot study involving 30 students outside the study sample. The results demonstrated acceptable internal consistency, with a

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Cronbach's alpha of 0.82 for the knowledge items and 0.79 for the behavior items (Nunnally & Bernstein, 1994).

The questionnaire instrument was tested for validity on 30 respondents by analyzing the correlation between the score of the item and the total score. Reliability was tested using Cronbach's Alpha, with results showing that the instrument was declared valid and reliable for use

Intervention

The intervention in this study consisted of two types of health education media—video and leaflet—which were designed to improve students' knowledge and behavior regarding waste sorting. In the video group, participants received health education through three short audiovisual materials for approximately 11 minutes. The videos covered the types of waste (organic, inorganic, and hazardous), the importance of proper waste management for health and the environment, and demonstrations of correct waste sorting practices. The sessions were conducted in classrooms using a projector and speakers, lasting about 20–25 minutes, including brief explanations and discussions to reinforce understanding. In the leaflet group, students received printed materials developed by the researchers containing concise explanations and illustrations about waste types, sorting steps, and environmental impacts. The leaflets were distributed to each student, who read and discussed the content under researcher guidance for around 20 minutes, and were encouraged to review the material at home. Both interventions were implemented after the pretest and followed by a posttest one week later to assess changes in knowledge and behavior. Each group received only one intervention type to ensure comparability, and all sessions were conducted during regular class hours under the supervision of trained enumerators to maintain consistency and adherence to the research protocol.

Data Collection

The intervention media included three educational audiovisual videos (total duration: 11 minutes) covering topics such as types of waste, proper disposal, and public service announcements, as well as a leaflet containing key waste-sorting information distributed to students. Examples of the leaflet and still images from the videos are provided in the Appendix. Secondary data were also obtained from the Cilegon City Education and Culture Office and the Cilegon City Environment Office to contextualize the intervention.

Data Analysis

Data analysis was carried out in several stages. Univariate analysis was used to describe respondent characteristics, knowledge levels, and student behavior before and after the intervention. Bivariate analysis was conducted to test the differences in the effectiveness of video media and leaflet media on students' knowledge and behavior. The statistical tests used were the paired t-test or the Wilcoxon signed-rank test to compare pretest and posttest scores within groups, while the independent t-test or the Mann–Whitney U test was applied to compare results between groups, depending on the data distribution. Prior to hypothesis testing, assumption tests were performed, including the Shapiro–Wilk test to assess data normality and Levene's test to verify homogeneity of variances. Effect sizes were reported using Cohen's d for parametric tests and r for non-parametric tests to complement p-values and provide an estimate of the magnitude of the intervention's impact. The level of statistical significance was set at $\alpha = 0.05$. All analyses were performed using IBM SPSS Statistics version 25 (IBM Corp., Armonk, NY, USA).

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Missing data were handled using a listwise deletion approach; however, no missing responses were recorded in this study, ensuring complete data analysis from all 60 participants.

Ethical Considerations

This study obtained ethical approval from the Research Ethics Committee of the Faculty of Public Health, University of Indonesia (Approval No. 123/UN2.F10/PPM.00.02/2024). Prior to data collection, permission was granted by the Cilegon City Education Office and the principals of the participating schools. Written informed consent was obtained from both the students' parents or guardians and the school authorities, while verbal assent was obtained from the students to ensure voluntary participation. All participants were informed about the study objectives, procedures, potential benefits, and their right to withdraw at any time without penalty. Confidentiality and anonymity were strictly maintained by using coded identifiers instead of personal names, and the collected data were used solely for research purposes. The study adhered to the principles of the Declaration of Helsinki regarding ethical conduct in research involving human participants.

Results

Table 1 illustrates that the study involved 60 fifth-grade elementary school students with a mean age of 10.7 ± 0.5 years. Most respondents were 10 years old (36 students, 60.0%), while 24 students (40.0%) were 11 years old. The gender distribution was relatively balanced, consisting of 32 males (53.3%) and 28 females (46.7%). Each participating school contributed an equal number of respondents, with 30 students (50.0%) from SDN Panggung Rawi and 30 students (50.0%) from SDN Sukmajaya 1. In terms of previous environmental education, 38 students (63.3%) reported having prior exposure, while 22 students (36.7%) had not received any related instruction. All participants completed both pretest and posttest assessments, resulting in a 100% response rate.

Table 1. Demographic Characteristics of Respondents (n = 60)

Variable	Category	n (%)	Mean ± SD
Age (years)	10	36 (60.0)	10.7 ± 0.5
	11	24 (40.0)	
Gender	Male	32 (53.3)	
	Female	28 (46.7)	
School	SDN Panggung Rawi	30 (50.0)	
	SDN Sukmajaya 1	30 (50.0)	
Prior environmental education	Yes	38 (63.3)	
	No	22 (36.7)	
Participation status	Completed study	60 (100.0)	

Table 2 illustrates that there was a significant improvement in students' knowledge scores following health education in both intervention groups. In the video group, the mean knowledge score increased from 7.93 ± 2.26 before the intervention to 9.93 ± 2.23 after the intervention ($p < 0.001$, Wilcoxon test). In the leaflet group, the mean knowledge score also increased significantly from 7.23 ± 1.99 to 10.77 ± 1.43 ($p < 0.001$, Wilcoxon test). These findings indicate that both audiovisual and printed media were effective in enhancing knowledge of waste sorting among elementary school students. However, the greater mean difference

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observed in the leaflet group suggests a stronger short-term cognitive effect, although video-based education provided a more engaging learning experience.

Table 2. Knowledge Scores Before and After Health Education in Video and Leaflet Groups (n = 60)

Group	Measurement	Mean ± SD	Minimum	Maximum	p-value*
Video (n = 30)	Before	7.93 ± 2.26	3	12	
	After	9.93 ± 2.23	5	12	< 0.001
Leaflet (n = 30)	Before	7.23 ± 1.99	1	10	
	After	10.77 ± 1.43	8	12	< 0.001

* Within-group comparison using Wilcoxon signed-rank test at α = 0.05..

Table 3 illustrates that students' waste sorting behavior significantly improved after exposure to both educational media. In the video group, the mean behavior score increased from 1.43 ± 0.68 before the intervention to 2.87 ± 1.20 after the intervention ($p < 0.001$, Wilcoxon test). In the leaflet group, the mean behavior score improved from 0.90 ± 0.71 to 3.50 ± 0.90 ($p < 0.001$, Wilcoxon test). These results demonstrate that both interventions successfully promoted positive behavioral changes related to waste sorting. The improvements were more pronounced in the leaflet group, indicating that written materials may have reinforced understanding and practice when supported by visual aids and teacher guidance.

Table 3. Behavior Scores Before and After Health Education in Video and Leaflet Groups (n = 60)

Group	Behavior	Mean ± SD	Minimum	Maximum	p-value*
Video (n = 30)	Before	1.43 ± 0.68	1	4	
	After	2.87 ± 1.20	1	4	< 0.001
Leaflet (n = 30)	Before	0.90 ± 0.71	0	2	
	After	3.50 ± 0.90	1	4	< 0.001

* Within-group comparison using Wilcoxon signed-rank test at α = 0.05..

Table 4 illustrates that there were significant differences between the video and leaflet groups in terms of both knowledge and behavior improvement. The mean increase in knowledge was 2.00 ± 2.90 in the video group and 3.53 ± 1.48 in the leaflet group ($p = 0.001$, independent t-test), indicating that leaflet media resulted in a greater overall knowledge gain. In terms of behavior, the mean increase was 1.43 ± 0.52 in the video group and 2.60 ± 0.67 in the leaflet group ($p = 0.001$, Mann–Whitney U test), confirming a statistically significant difference between the two interventions. These findings suggest that while both media were effective, leaflet-based education demonstrated higher measurable improvement, possibly due to its structured content and take-home nature that allowed repeated exposure.

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Table 4. Comparison of Knowledge and Behavior Improvements Between Video and Leaflet Groups

Variable	Group	Mean Difference ± SD	Std. Error	p-value	Test Used
Knowledge	Video	2.00 ± 2.90	0.53	0.001	Independent t-test
	Leaflet	3.53 ± 1.48	0.27		
Behavior	Video	1.43 ± 0.52	0.15	0.001	Mann–Whitney U test
	Leaflet	2.60 ± 0.67	0.12		

Between-group comparison using Independent t-test or Mann–Whitney U test depending on data distribution (α = 0.05).

Discussion

The results of the study showed that students' knowledge before being given health education was still relatively low, both in the group that received intervention with videos and leaflets. This is reflected in the fact that there are still students who are not able to distinguish organic, inorganic, and B3 waste, and do not understand the importance of good waste bin requirements. The low level of knowledge before intervention can be influenced by the lack of socialization regarding waste sorting in schools, even though bin facilities are available.

After receiving health education, both groups showed a significant increase in knowledge; however, the improvement was greater in the video media group than in the leaflet group. This finding aligns with the Knowledge–Attitude–Practice (KAP) model, which posits that enhancing knowledge is a critical first step in shaping positive attitudes and influencing subsequent behaviors (Notoatmodjo, 2012; Green & Kreuter, 2005). Audiovisual media, grounded in principles of educational psychology, stimulate visual and auditory sensory channels, facilitating deeper cognitive processing, better retention, and higher student engagement. The dynamic combination of sound, motion, and real-life visuals helps learners connect abstract information to concrete experiences, reinforcing understanding and motivation to learn. In contrast, leaflets, although effective in improving knowledge to some extent, rely primarily on reading comprehension and intrinsic motivation, which may limit their impact on younger learners who benefit more from interactive and multisensory learning experiences.

This finding is in line with the findings of (Notoatmodjo, 2018) who stated that knowledge is the result of the process of sensing and processing information. Media that is able to stimulate more than one sense, such as video, tends to be more effective in increasing knowledge than print media (Fuadi, 2021). Thus, it can be concluded that health education with audiovisual media has advantages in improving students' understanding of waste sorting.

The results of the study showed that before the intervention, student behavior in waste sorting was still relatively low. Most students are not used to sorting waste by type, even though school has sorted bins. This shows that there is a gap between knowledge and practice, where low knowledge has implications for poor behavior. In addition, the lack of habituation from the school and family also contributes to the low behavior of sorting waste.

After being given health education, students' behavior showed positive changes in both groups. Students began to understand the importance of sorting waste and try to apply it in daily life at school. Behavioral improvements were higher in the group that used video compared to leaflets. This can be explained through the approach of health behavioral theory, where stimuli in the form of audiovisual impressions are able to provide a real

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picture that creates a deeper impression, so that students are more encouraged to take real actions. In contrast, leaflets tend to only add insight, but are not particularly powerful in motivating behavior change due to their limited nature of presentation to static text and images.

This is in accordance with what was stated by Lawrence and Green in Notoatmodjo (2014), healthy behavior can be formed due to various influences or stimuli in the form of knowledge, attitudes, experiences, beliefs, social, cultural, physical means, influences or stimuli that are internal. In a formation or change, behavior is influenced by several factors that come from within and outside the individual himself. One of the predisposing factors influenced by health behavior includes knowledge, public attitudes and public trust in health-related matters. The value system embraced by the community is influenced by education, and socio-economics (Musdalifah et al., 2022).

Statistical analysis showed significant differences between pre- and post-intervention knowledge in both the video and leaflet groups. In the video group, the increase in the average knowledge score was higher than in the leaflet group. These results confirm that both media are effective in increasing knowledge, but video media has a greater impact.

The effectiveness of video in improving knowledge is inseparable from its ability to integrate sound, text, and images simultaneously, making it easier for elementary school-age children to understand. According to (Heriyanto, 2019), children at the age of ≥ 9 years have better cognitive development if information is presented visually and contextually. Therefore, the delivery of information through video is more in accordance with the characteristics of elementary school students.

Meanwhile, leaflets are also effective in increasing knowledge, especially in students who have good reading skills. Leaflets serve as a supporting medium that allows students to reread the information that has been given. However, due to its attention-grabbing and motivational nature of reading, the upscaling effect is not as large as the video. Thus, videos are more recommended to increase knowledge quickly and thoroughly, while leaflets can be used as complementary media.

This research is supported by the research of (Fuadi, 2021), based on the results of the statistical test, it was concluded that there was a significant difference between the knowledge before and after the existence of health education on waste sorting using video.

Another study conducted by (Rianti et al., 2020), based on the results of statistical tests was obtained, so it was concluded that there was a significant difference between the knowledge before and after health education about waste sorting using leaflets.

The use of video media and leaflets aimed to deliver messages about waste sorting, as no structured health education program had previously been conducted at SDN Panggung Rawi or SDN Sukmajaya 1, despite the presence of waste sorting facilities. The interventions successfully increased students' knowledge about waste and its types, with video media demonstrating superior effectiveness compared to leaflets. This result is consistent with Cognitive Learning Theory and Mayer's Multimedia Learning Theory, which emphasize that learning is enhanced when information is presented through both visual and auditory channels, enabling dual coding and reducing cognitive overload. Videos facilitate active engagement by integrating narration, motion, and contextual visualization, allowing students to process and store information more efficiently in long-term memory (Mayer, 2024). Similar findings

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have been reported internationally for instance, Sueb et al., (2024) found that audiovisual media improved students' environmental literacy and retention more effectively than printed materials, while Chen & Jamiat (2023) showed that multimodal instruction increased motivation and comprehension among elementary learners. In contrast, static and text-based leaflets rely primarily on reading ability and intrinsic motivation, making them less effective for young learners whose cognitive development favors interactive and experiential forms of learning. Thus, video media's multimodal and immersive nature offers a richer learning experience, supporting stronger conceptual understanding and behavioral reinforcement in school-based environmental education.

The comparison of behaviors before and after health education showed significant improvements in both the video and leaflet groups, with the video group demonstrating a higher behavioral increase. This finding indicates that audiovisual media provides stronger stimulation for students to translate knowledge into action. Videos combine visual and auditory elements, making abstract concepts such as waste classification easier to understand and modeling the correct behaviors directly. (Isnaini & Bahrah, 2019), confirmed this by reporting a significant increase in students' knowledge after video-based health education, highlighting the effectiveness of audiovisual approaches in enhancing comprehension and retention compared to print media.

These results are consistent with prior research showing the superiority of audiovisual media in changing health-related behaviors. For example, Susanti et al. (2021) found that video interventions significantly improved handwashing behavior among elementary school students compared to conventional lecture methods. Similarly, international studies, such as those by Moya et al. (2019) in the Philippines, showed that video-based environmental education increased recycling practices more effectively than posters or leaflets, due to the dynamic presentation of content. Together, these findings strengthen the evidence that school-based health education is more impactful when delivered through interactive and engaging audiovisual media, increasing knowledge and fostering sustained behavioral change.

Another study conducted by (Rianti et al., 2020), based on the results of statistical tests, health education using leaflets had a statistically significant impact on students' waste sorting behavior. This finding indicates that even simple printed media, when systematically delivered, can effectively influence behavioral outcomes. The structured information in leaflets helps students recognize and differentiate types of waste, which serves as the foundation for adopting better waste management practices.

The observed behavioral change among elementary school students from incorrect to correct and from poor to good practices reflects the role of health education as a catalyst for awareness and habit formation (Newsome et al., 2023). Prior to the intervention, students lacked sufficient understanding of waste classification, but after receiving targeted education, they showed measurable improvements in knowledge and daily actions. This demonstrates that even in the absence of advanced digital tools, traditional media such as leaflets remain valuable in shaping environmentally responsible behavior in young learners (Conti et al., 2024). These findings are consistent with studies from other countries, such as Ghana, where school-based leaflet campaigns enhanced student participation in recycling programs (Achi et al., 2025).. This demonstrates that

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even in the absence of advanced digital tools, traditional media such as leaflets remain valuable in shaping environmentally responsible behavior in young learners across diverse contexts.

The change in the behavior of elementary school students in waste sorting from incorrect to correct, from bad to good is obtained from the results of health education. Before the existence of health education, students still did not understand the types of waste. After health education was carried out, there was a positive change in behavior regarding waste sorting.

According to (Mahendra et al., 2019), the health education provided will provide a process of change so that a new behavior is created. The health education process requires health promotion media or teaching aids so that the message or information that the communicator wants to convey, be it through print, electronic, and outdoor media, so that the target can increase his knowledge which is finally expected to change his behavior in a positive direction. The existence of props is intended to exert as many senses as possible on an object so as to facilitate understanding. This study's media used in health education are video media and leaflets.

Implications and limitations

The findings of this study have important implications for school-based health education programs, suggesting that both video and leaflet media can effectively enhance elementary students' knowledge and behavior regarding waste sorting, with leaflet-based interventions showing slightly greater improvements. Integrating audiovisual and printed materials into the school curriculum may provide a practical approach to promoting environmental health awareness and fostering sustainable behavioral changes among children. However, the study has several limitations that should be considered. The sample was limited to only two schools in a single district, which may reduce the generalizability of the findings to other regions or populations. The intervention period was short, and follow-up assessments were not conducted, limiting the ability to evaluate the long-term sustainability of knowledge and behavioral changes. Additionally, self-reported measures for behavior may be subject to response bias. Future studies with larger, more diverse samples, longer intervention and follow-up periods, and objective behavioral assessments are recommended to strengthen the evidence and guide broader implementation strategies.

Relevance to for Practice

The results of this study are highly relevant for nursing and public health practice, highlighting the value of integrating both audiovisual and printed educational media into school-based health promotion programs. By demonstrating that video and leaflet interventions can significantly improve children's knowledge and waste-sorting behavior, this study provides practical evidence for teachers, school nurses, and health educators to adopt multimodal strategies that engage students effectively. Implementing such interventions can foster early development of environmental health literacy, promote sustainable waste management behaviors, and contribute to a healthier school and community environment. The findings also support the design of structured educational materials that are age-appropriate, visually engaging, and accessible, ensuring that health education efforts are both effective and sustainable in daily school practice

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Conclusion

This study aimed to examine the effectiveness of video and leaflet-based health education in improving waste sorting knowledge and behavior among elementary school students. The findings demonstrate that both media are effective, but audiovisual media yield greater improvements than print materials, highlighting their suitability for younger learners. Practically, these results emphasize the value of integrating engaging audiovisual tools alongside printed materials into school-based health education programs to foster sustainable waste management behaviors from an early age.

The practical implications of this study highlight the importance of integrating health education programs on routine waste sorting into schools by utilizing engaging and interactive educational media. However, several limitations should be noted: the study involved a relatively small sample size, was limited to only two schools, included a short follow-up period, and did not assess long-term retention of knowledge or behavior change. Despite these limitations, the findings suggest that incorporating waste sorting into the school curriculum and encouraging its adoption as an institutional policy could strengthen sustainable waste management practices and foster lifelong environmental responsibility among students.

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CrediT Authorship Contributions Statement

Sadya Bustomi : Conceptualization, Methodology, Data Collection

Della Sulistiana : Data Analysis, Writing – Original Draft, and Writing – Review & Editing

Conflicts of Interest

The authors declare no conflict of interest regarding the publication of this article.

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