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Development of an Integrated Helminthiasis Prevention Education Model in Elementary Schools: Utilizing Picture Storybooks and Storytelling as Learning Media

Armaidi Darmawan[1*], Ahmad Syauqy[2], Andika Sulistiawan[3], Wahyu Indah Dewi Aurora[1], Erny Kusdiyah[1]

[1] Public Health Departement, Faculty of Medicine and Health Science Universitas Jambi, Jambi City, Indonesia.
[2] Biomedical Departement, Faculty of Medicine and Health Science Universitas Jambi, Jambi City, Indonesia.
[3] Nursing Departement, Faculty of Medicine and Health Science Universitas Jambi, Jambi City, Indonesia.

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Corresponding Author:
Armaidi Darmawan
armaididarmawan@unja.ac.id

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Abstract: Helminthiasis remains a significant health issue, especially in developing countries like Indonesia, where the prevalence among elementary school children ranges from 31.8% to 80%, particularly in areas with poor sanitation. This condition can cause anemia, malnutrition, cognitive impairment, and reduced academic performance. Therefore, an effective school-based prevention model is necessary. This study aimed to develop and evaluate an educational model for helminthiasis prevention using picture storybooks and storytelling. A mixed-methods approach was used, involving qualitative validation by experts and quantitative analysis through pre- and post-tests. A total of 100 respondents, including teachers, parents, and health officers, participated in a survey assessing their knowledge of helminthiasis prevention and school sanitation conditions. The effectiveness of the educational intervention was analyzed using paired t-tests. Results showed that majority of 70% of respondents are aware of helminthiasis. Regarding school sanitation, 55% of respondents disagree that the sanitation in elementary schools is adequate. Statistical analysis indicated a significant improvement in students' understanding post-intervention ($t = 16.65$, $p = 0.002$). This study confirms that picture storybooks and storytelling effectively enhance students' awareness and understanding of helminthiasis prevention. Further research is recommended to evaluate the long-term impact of this intervention.

Keywords: Helminthiasis; Picture Storybook; Sanitation; Storytelling

Introduction

Helminthiasis or worm infections remain a global health issue that has not been fully resolved, especially in developing countries. Previous studies have highlighted the prevalence of intestinal worm infections across various regions and emphasized the importance of proper interventions (Adrial et al., 2020; Bria et al., 2022). In Indonesia, the prevalence of helminthiasis among children is still quite high, ranging from 45% to 65%, and in areas with poor environmental conditions, it can reach up to 80%. A 2012 survey on helminthiasis in elementary school children revealed a high infection rate of about 60-80%, while a 2016 survey across 398 elementary schools in 33 provinces found an average prevalence of 31.8% (Maria et al., 2023) .

The development of an integrated helminthiasis control model in schools is urgently needed, particularly one that involves a health education approach for elementary school children. The research and

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development method, which includes preliminary studies, development stages, testing on a small scale and larger scale, as well as the final model validation (Salamor, 2022).

The persistently high prevalence of helminth infections among elementary school children in Indonesia highlights significant gaps in current control efforts. While mass deworming programs have been implemented in schools, these initiatives often operate in isolation and are not accompanied by supporting strategies such as health education, sanitation improvement, or behaviour change promotion (Enogiomwan et al., 2023; Rohmah et al., 2022). As a result, the impact of deworming is often temporary, and children remain vulnerable to reinfection. Sustainable reduction in infection rates requires a more holistic approach that addresses the underlying environmental and behavioural risk factors (Chard et al., 2019; Esum et al., 2020).

The urgency of this research lies in the significant health burden posed by helminthiasis, which leads to anemia, malnutrition, cognitive impairment, and reduced academic performance in children (Donkoh et al., 2022; Tandoh et al., 2019). Addressing helminthiasis through engaging, age-appropriate educational interventions is critical to breaking the cycle of infection, improving children's quality of life, and supporting long-term educational and economic outcomes (Donkoh et al., 2022; Han et al., 2019; Oswald et al., 2019). This study is important to fill the gap in effective, child-centered educational models for disease prevention and to respond to the specific health challenges faced by schoolchildren in Jambi City.

Method

This study employed a mixed-methods approach consisting of qualitative validation from experts and quantitative analysis through pre- and post-tests to evaluate the effectiveness of an educational model for helminthiasis prevention using a picture storybook. The methodology was divided into three key components: development and validation of educational materials, survey distribution for assessing awareness and knowledge, and statistical analysis of pre- and post-test scores.

The educational materials were developed in the form of a picture storybook designed to teach elementary school children about helminthiasis prevention (Syamsuarni & Eliza, 2020). The picture storybook incorporated engaging visuals, simple language, and interactive elements such as quizzes and games to facilitate comprehension and retention. The materials aimed to communicate key messages about the importance of sanitation and hygiene in a child-friendly manner (Erismann et al., 2016).

To ensure the appropriateness and quality of the educational materials, a validation process was conducted with environmental health experts, including public health and health promotion specialists. The experts were asked to evaluate the materials based on several criteria, including the appropriateness for children's understanding, the quality of visuals, clarity of language, interactivity, completeness of information, ease of implementation, and relevance to school conditions. Feedback from the experts led to the incorporation of suggestions such as simplifying language further and adding more visual examples to strengthen the materials' effectiveness.

In this study, a questionnaire was distributed to 100 respondents, consisting of teachers, parents, and health officers, to assess their awareness and knowledge regarding helminthiasis prevention and school sanitation conditions. The main objectives of the survey were to understand the level of awareness about helminthiasis, the perceptions of sanitation in schools, handwashing habits among students, and the general support for hygiene education and deworming programs (Addun et al., 2021).

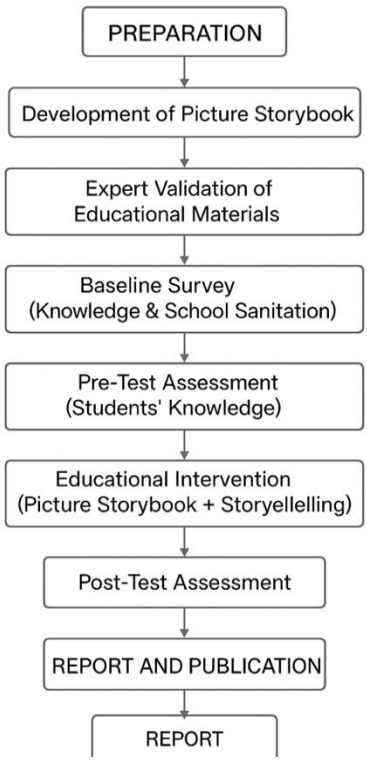

Figure 1. Research Flowchart

The primary data for evaluating the effectiveness of the educational model was collected through pre-tests and post-tests administered to elementary school

students. The pre-test was conducted before the implementation of the educational model to assess the students' baseline knowledge of helminthiasis prevention (Pradhan et al., 2020). After the students were exposed to the picture storybook, a post-test was administered to measure any improvement in their understanding. The students' scores were compared using a paired t-test to determine if there was a statistically significant improvement in knowledge after the educational intervention (Jaswandi & Kurniawati, 2023).

The data collected from the pre-test and post-test were analyzed using paired t-test statistics to compare the change in students' knowledge. The t-test results were used to assess whether the difference between pre-test and post-test scores was statistically significant.

This study was conducted with the approval of the appropriate educational authorities and ethical clearance from relevant committees. Informed consent was obtained from parents and guardians of the students involved in the study, and all data were anonymized to ensure participant confiden-tiality . While the study demonstrated significant improvements in knowledge, some limitations should be noted. The study was conducted in a specific geographic area (Jambi City), which may limit the generalizability of the findings to other regions. Additionally, the duration of the intervention was limited, and long-term effects of the educational materials were not assessed. Further research is needed to explore the sustained impact of this educational model over time.

Result and Discussion

Based on the validation results from environmental health experts (Table 1.), it can be concluded that the developed educational materials for helminthiasis prevention, in the form of a picture storybook, are quite good and appropriate for the needs of elementary school children. The experts provided high scores for aspects such as visual quality, interactivity, and alignment with the objectives of helminthiasis prevention. This indicates that the picture storybook effectively captures the students' attention and conveys the key messages related to the importance of sanitation and hygiene. The use of engaging visuals in the storybook helps to make the learning process more accessible and enjoyable for young learners, ensuring the effectiveness of the educational materials in promoting awareness and understanding of helminthiasis prevention.

Table 1. Validation Results of Educational Material in the Form of a Picture Story Book by Experts (Public Health and Health Promotion Specialists)

Aspect Evaluated	Rating (Scale 1-5)	Comments/Feedback
Appropriateness of material for children's understanding level	4.00	The material is quite simple, but more visual examples are needed.
Quality of material visualization	5.00	The use of images and colors is very good for attracting children's attention.
Clarity of language used	4.00	The language is easy to understand, but some terms could be further simplified.
Interactivity of the material	5.00	Materi interaktif seperti kuis dan permainan sangat membantu pemahaman siswa.
The material aligns well with the goal of worm prevention and covers important aspects.	5.00	Interactive elements like quizzes and games greatly aid students' understanding.
Completeness of information	4.00	The information provided is fairly comprehensive but could be strengthened with deeper explanations on worms and prevention methods.
Ease of implementation in schools	5.00	The material is easy to implement in school settings with support from teachers.
Parental involvement in education	4.00	Parental roles are accommodated, but additional guidance for parents would be beneficial.
Relevance of material to field conditions	5.00	The material is highly relevant to the sanitation and hygiene conditions in elementary schools.

Note:
Rating scale 1-5, with 1 = Very Inadequate, 5 = Very Adequate Feedback from the experts indicates that the materials are appropriate, but some sections still require simplification and the addition of more visual examples to strengthen students' understanding.

However, there were some notes provided by the experts. One of the suggestions was to add more visual examples to clarify the explanations related to helminthiasis and preventive measures. Additionally, the language used is generally easy for children to understand, though some terms could be simplified further to better match their comprehension levels. The experts also emphasized the importance of parental involvement in the educational process, recommending supplementary guidelines for parents to reinforce the program at home.

Overall, the experts gave very positive feedback and stated that the materials are relevant and easy to implement in elementary schools. The suggested improvements are minor and aim to further enhance the effectiveness of the material delivery to both students and parents.

Table 2. Results of the Questionnaire for Teachers, Parents, and Health Officers on Integrated Helminthiasis Prevention in Schools

Questions	Answer Agree (%)	Answer Disagree (%)	Answer Don't Know (%)
Do you know about helminthiasis?	70	20	10
Do you think sanitation in elementary schools is adequate?	40	55	5
Do students frequently wash their hands before meals at school?	35	60	5
Have you ever participated in helminthiasis prevention education programs?	50	40	10
Do you think schools need to provide further education on helminthiasis prevention?	85	10	5
Do you feel the need to be involved in educating children about sanitation and hygiene at school?	90	5	5
Do you support the implementation of regular deworming programs in schools?	80	15	5
Do you think the condition of the school toilets is clean and suitable for use?	30	65	5
Do you know how to prevent helminthiasis?	60	30	10
Have you received information from the school related to cleanliness and sanitation?	55	40	5

The results of the questionnaire (Table 2) show varying levels of awareness and support regarding helminthiasis prevention in schools. A majority of 70% of respondents are aware of helminthiasis, though 20% are not familiar with the disease, and 10% are unsure. Regarding school sanitation, 40% of respondents believe that the sanitation in elementary schools is adequate, but a significant 55% disagree, and 5% are uncertain. This indicates a need for improvements in school sanitation. When asked about students' handwashing habits before meals, 35% of respondents agreed that students frequently wash their hands, while the majority (60%) disagreed, suggesting a lack of proper hygiene practices among students.

Regarding education on helminthiasis prevention, 50% of respondents have participated in such programs, with 40% having no prior involvement and 10% unsure. Despite this, there is strong support for further education, as 85% of respondents believe schools should provide more information on prevention, with only 10% disagreeing. Furthermore, 90% of respondents expressed the need for their involvement in educating children on sanitation and hygiene, while only 5% disagreed. The support for regular deworming programs is also strong, with 80% of respondents in favor, while 15% are against it.

However, concerns about sanitation remain, particularly regarding the cleanliness of school toilets. Only 30% of respondents felt that the toilets were clean and suitable for use, while 65% disagreed, highlighting a significant issue with sanitation facilities in schools. Lastly, 60% of respondents are aware of the methods to prevent helminthiasis, while 30% are not, and 10% are unsure. This indicates that while there is some awareness, there is still a need for more comprehensive education on the topic.

Table 3. Results of Model Implementation Using Paired t-test

Score Range	Pre-Test Frequency	Post-Test Frequency	t-statistic	p-value
0-20	0	0	16.65	0.002
21-40	13	1		
41-60	17	10		
61-80	0	13		
81-100	0	6		

Based on the data analysis results (Table 3), the distribution of pre-test scores shows that the majority of students fell within the score range of 41-60 (17 students) and 21-40 (13 students), indicating that, prior to the intervention, the students' knowledge of helminthiasis prevention was relatively low. After the implementation of the educational model, a significant shift in the score distribution was observed. Thirteen students reached the 61-80 score range, and six students scored between 81-100, while only one student remained in the 21-40 range. This indicates a substantial improvement in understanding following the educational intervention.

The paired t-test results support this observation, with a t-statistic value of 16.65 and a very small p-value (0.002). The p-value being less than 0.05 indicates that the increase in scores from the pre-test to the post-test is statistically significant. Therefore, it can be concluded that the educational model implemented was effective in enhancing students' knowledge regarding helminthiasis prevention.

Helminthiasis remains a significant public health concern in regions with low socioeconomic conditions, and there is a compelling need to incorporate health promotion within the school curriculum (Nasution et al., 2023; Putri et al., 2021).

Using narrative-based visual media, such as picture storybooks, can bridge the gap between abstract scientific concepts and tangible, relatable scenarios. In doing so, students are exposed to vital information regarding parasite transmission and preventive hygiene practices and are encouraged to adopt behaviors that mitigate health risks (Salim et al., 2024; Zahra & Isdaryanti, 2025).

The results of this study highlight the effectiveness of the educational materials developed for helminthiasis prevention, as validated by experts. These materials were deemed appropriate for elementary school students, with strong visual quality and interactivity that successfully captured students' attention. Research by Balaman & Ataman (2022) emphasizes the impact of digital storytelling in preschool values education. They found that teachers perceive digital stories as more engaging and beneficial compared to traditional methods. The multimedia elements inherent in digital storytelling not only captivate students' attention but also facilitate their learning processes by providing immersive experiences that traditional teaching methods lack. This finding aligns with existing literature demonstrating the positive impact of multimedia elements on learning, reinforcing the idea that digital stories serve as effective educational materials for fostering engagement and comprehension.

The integration of storytelling with picture books emphasizes active learning and student engagement. Evidence from studies employing comic media and videos for health promotion has demonstrated significant improvements in knowledge and practices related to helminthiasis among target audiences (Alika & Radia, 2021; Maryani et al., 2022). Moreover, storytelling methodology allows students to internalize health messages by relating the narrative experiences of characters to their own lives, thereby reinforcing preventive measures for helminth infections. This narrative approach offers a memorable context, which is critical when addressing complex health issues in an elementary educational setting (Nisyaa et al., 2025; Salim et al., 2024).

The choice of interactive visual media is supported by research showing that educational materials, such as booklets and videos, enhance health knowledge in various communities (Indrawati et al., 2023).

The narrative structure of picture storybooks also facilitates cognitive engagement and reading comprehension. For instance, children tend to perform better on comprehension questions when using reprint illustrations compared to original illustrations, suggesting that the brighter colors and clearer presentation of reprint illustrations may contribute to more effective comprehension of the story (Sun, 2023). This visual reinforcement aids children in grasping the narrative's context, as evidenced by research showing increased engagement with the material during discussions (Papen & Peach, 2021). Moreover, picture books can serve as effective educational tools in classrooms, especially for disadvantaged children, by promoting positive thinking and problem-solving strategies through structured storytelling (Huang, 2022).

Another key aspect of picture storybooks is their relevance to cultural education. Jambak & Eliza (2020) discuss how picture books that highlight indigenous cultures can enrich children's literacy skills while building character. Such cultural narratives educate children about diversity and strengthen their identity and belonging in a multicultural society (Salamah et al., 2023). Furthermore, incorporating wordless picture books is valuable for bilingual families as it allows for creative storytelling that transcends language barriers, thus promoting inclusive literacy practices (Moody & Matthews, 2022).

Interactive elements in educational picture books further enhance engagement and learning outcomes. For example, integrating technology with electronic picture books provides an innovative approach to literacy that aligns with modern educational needs (Zananda, 2020). The rise of interactive storybooks underscores the importance of tactile and sensory experiences in learning, as these elements foster deeper connections with the story and stimulate children's imaginations

(Simeon & Pugh-Kitingan, 2021). Gathering input from experts in educational media enhances the reliability of the media and encourages its effective use in the classroom (Nuraini et al., 2024; Zahra & Isdaryanti, 2025).

Our survey found that 55% of respondents expressed dissatisfaction with the adequacy of sanitation facilities in schools. This response points to a significant public health issue, as inadequate sanitation is closely linked to the transmission of helminthiasis and other communicable diseases. Poor sanitation facilities can exacerbate the risk of infection, especially in school settings where children are particularly vulnerable. Inadequate sanitation is not only a health issue; it also affects academic performance and overall well-being. Studies have demonstrated that improved sanitation leads to better health outcomes, resulting in enhanced school attendance and educational attainment. Conversely, schools with unsatisfactory sanitation facilities may reinforce cycles of infection and absenteeism, adversely impacting children's education (Botabara-Yap & Bellosillo, 2019).

The alarming statistic that 60% of respondents report students do not consistently wash their hands before meals points to a critical lapse in basic hygiene practices within educational settings. This finding mirrors broader research indicating low compliance with handwashing protocols, particularly in children, which can exacerbate the transmission of infections such as helminthiasis.

Effective hand hygiene is established as a primary strategy to reduce the spread of intestinal parasites. As noted by Paunović & Jovanović (2022), children often lack the requisite knowledge about the importance of handwashing, particularly when it comes to preventing infections linked to food and water . Furthermore, factors such as inadequate soap supply and insufficient sanitation facilities diminish the possibility of effective handwashing practices in schools, contributing further to the health risks associated with helminthiasis.

The survey data reflecting an 85% support for additional education on helminthiasis prevention emphasizes a clear recognition of the need for informed health practices among students. According to Fida et al. (2023) integrating health education programs that focus on hygiene practices can significantly ameliorate the health and well-being of schoolchildren. These programs should also address critical information on when and how to wash hands effectively, alongside the importance of hygiene in preventing various infectious diseases.

Studies have demonstrated that educational interventions can substantially elevate awareness and implementation of hygiene practices among students, leading to improved health outcomes . Interactive and engaging methods, such as storytelling and illustrated educational materials, could reinforce these concepts effectively (Jaswandi & Kurniawati, 2023).

The use of picture storybooks and storytelling as educational tools has gained substantial traction in early childhood education. These methods not only foster children's literacy but also play a crucial role in enhancing their overall cognitive and emotional development. Recent literature underscores the multifaceted benefits of these educational models, highlighting their effectiveness in promoting engagement, understanding complex concepts, and fostering a love for learning among young children.

Storytelling captivates children's imaginations, creating an interactive learning environment in which they are active participants. According to Puteri and Emini, storytelling can facilitate understanding by engaging multiple senses, which enhances children's ability to grasp new concepts. This multisensory engagement is critical in early education, as it reinforces learning through emotional and cognitive connections to the material. For instance, vibrant illustrations in picture books capture children's attention and provoke curiosity, which is essential for effective learning. This understanding is supported by findings from holistic approaches to educational strategies emphasizing visual storytelling techniques (Kurniatin & Aryani, 2021).

Moreover, digital storytelling introduces a modern twist on traditional storytelling methods. Hoa and Minh discuss how digital storytelling integrates technology into early childhood education, enhancing children's learning experiences by making them more interactive and engaging (Tisnawijaya & Kurniati, 2024). This method not only caters to modern digital learners but also supports the development of essential technological skills, which are increasingly necessary in today's educational landscape.

Conclusion

In conclusion, this study confirms that picture storybooks and storytelling effectively enhance students' awareness and understanding of helminthiasis prevention. Further research is recommended to evaluate the long-term impact of this intervention. The development and implementation of an integrated helminthiasis prevention education model using picture storybooks and storytelling in elementary schools have shown significant potential in improving students' understanding of sanitation and hygiene practices. The use of visual and narrative elements in these educational materials effectively captures children's attention and

enhances their learning experience. Validation from experts indicates that the educational materials are well-suited to the needs of elementary school children, with minor recommendations for improvement, such as adding more visual examples and simplifying certain terms. Furthermore, the positive response from teachers, parents, and health officers highlights the importance of involving various stakeholders in the educational process. The data also reveals a need for improved sanitation in schools, which is critical in preventing helminthiasis and other related diseases. The educational model, supported by the use of interactive and engaging tools like picture storybooks, shows promise in raising awareness and promoting healthier behaviors among students. Overall, the study demonstrates that integrating creative and engaging teaching methods can significantly contribute to better health outcomes and enhanced academic performance in elementary school children.

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There is no conflict of interest in this research.

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