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An Impact of Interactive Multimedia Videos on Aedes Mosquito among Primary School Students in A Dengue Endemic Area

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Abstract

This study evaluated the effectiveness of interactive multimedia videos in enhancing and sustaining primary students' knowledge of Aedes mosquitoes and related diseases. Traditional textbook-based methods may not fully support deep learning, whereas multimedia offers a more engaging and student-centered approach. A total of 171 Standard Three students from two schools (control and intervention groups) participated. Using G*Power software, the sample size was determined, and a validated questionnaire was administered at three intervals. Data were analysed using a two-way mixed ANOVA. Findings showed that multimedia significantly improved comprehension and long-term retention, supporting its integration into primary health education curricula.

Keywords: Aedes; Health Education; Interactive Multimedia Videos; Teaching Aid.

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1.0 Methodology

Aedes mosquitoes present a significant and growing threat to global public health, particularly across tropical and subtropical regions (Samsudin et al., 2024a). These vectors are the primary carriers of several diseases, particularly dengue fever, which threatens millions

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globally (Samsudin et al., 2024b). As the primary vectors for several critical arboviruses, including dengue fever, chikungunya, yellow fever, Rift Valley fever, and Zika, they jeopardize the health of millions worldwide (Samsudin et al., 2024b; Zaini et al., 2019b). Reported dengue infections to the World Health Organization (WHO, 2024) have dramatically increased over the past few decades, rising from 505,430 cases in 2000 to 5.2 million in 2019. It is now estimated that up to 2.5 billion people are at risk of this disease, with an annual incidence of 100 to 400 million infections, making dengue the most globally significant mosquito-borne disease.

Conventional approaches, such as the application of larvicides and insecticides, have demonstrated limited long-term efficacy in controlling Aedes mosquitoes and preventing the spread of dengue (Buhler et al., 2019). Furthermore, despite various community-based prevention measures, many individuals continue to perceive mosquito control as a public responsibility rather than a personal initiative (Rahim, 2023). Consequently, health education activities are crucial for transforming this perception and promoting long-term behavioural change (Heyrani et al., 2024).

This study aimed to evaluate the effectiveness of a purpose-designed interactive multimedia video (IMV) teaching aid (TA) in improving knowledge about Aedes mosquitoes and Aedes-borne diseases among Year Three primary school students in a dengue-endemic district. The specific objectives were to determine whether students exposed to the IMV show greater immediate improvement in knowledge scores compared with students taught using the standard textbook-based approach, and secondly, to assess the retention of knowledge three months after the intervention in both groups.

2.0 Literature Review

2.1 Background

In Malaysia, dengue case mapping reveals that most hotspot clusters and outbreak areas are concentrated in residential zones. All age groups, including adults and children, are at risk of infection; however, children are particularly vulnerable. This is mainly because they spend a significant amount of time in endemic areas, both indoors and outdoors (Zaini et al., 2019a). Daily routines, such as school attendance and outdoor play, often coincide with the peak biting times of Aedes mosquitoes. These activities often occur near potential mosquito breeding sites, making children easy targets, reinforcing the importance of early educational interventions (Suwanbamrung et al., 2024). A study by Khun and Manderson (2007) in Cambodia further supports this, indicating that dengue fever has a significant impact on children. This age group is particularly susceptible due to inadequate protection and preventive measures against mosquito bites, underscoring the need for school-based interventions to enhance preventive practices (Suwanbamrung et al., 2024). More recently, Suwanbamrung et al. (2024) reported that a school-based dengue education model in Southern Thailand effectively improved preventive practices among students, reinforcing the importance of early educational interventions.

2.2 The Role of Health Education in Vector Control and School-Based Dengue Awareness

Health education is a crucial component of health promotion and vector control programs. These activities deliver necessary scientific knowledge to raise awareness, foster understanding (Zaini et al., 2019b), and may lead to positive behavioural changes (Aziz et al., 2014). School-based health education is essential in helping students recognise the seriousness of dengue and promoting the spread of knowledge and healthy behaviours from school to family environments (Jaroenpool et al., 2024). Recent evidence supports this approach, which found that the Integrated Dengue Education and Learning (iDEAL) module improved students' knowledge retention and participation (Dapari et al., 2024). A scoping review by Heyrani et al. (2024) highlighted that educational interventions using digital and participatory tools are among the most effective strategies for Aedes control globally. Increased knowledge influences individuals' attitudes and behaviours, ultimately leading to the adoption of recommended practices.

In Malaysia, the government has introduced a compulsory subject, Physical and Health Education (PJPK), at the school level. The curriculum for Year Three in primary school includes various diseases, including those related to Aedes mosquitoes and dengue fever. Teachers are responsible for delivering the content and ensuring students receive accurate information. Therefore, teachers must possess adequate knowledge to avoid disseminating incorrect facts. However, many teachers responsible for this subject are not trained specialists in the field (Rahman & Yusoff, 1997). Teaching and learning (T&L) activities that rely solely on textbooks may limit student learning, suggesting that supplementary instructional aids are necessary for effective information dissemination (Sidek & Hashim, 2016). Information dissemination becomes complex without proper TAs to assist teachers during T&L sessions. Choong (2008) suggests that a learning process incorporating diverse strategies is highly encouraged, as it enhances students' ability to absorb and internalise knowledge effectively.

2.3 The Role of Multimedia Video-Based Teaching Aids in Enhancing Learning about Aedes Mosquitoes and Related Diseases

Technological advancements have significantly impacted education. Multimedia refers to materials that combine more than one element, such as text, audio, images, animation, video, and interactive components. Video-based instruction is a medium that simultaneously presents audio and visual graphics, which can effectively support teachers during the T&L process (Sidek & Hashim, 2016). Modern instructional design frameworks, such as the Cognitive Theory of Multimedia Learning (CTML), emphasise the integration of visual and auditory information to optimise understanding (Mayer, 2024). Recent evidence shows that educational interventions using digital and participatory tools are among the most effective strategies for Aedes control globally (Heyrani et al., 2024). Learning videos can support teachers during the teaching and learning process, fostering a better understanding among students through varied instructional strategies (Sidek & Hashim, 2016). Recent empirical evidence demonstrated that school-based dengue education models effectively

improved preventive practices among students, reinforcing the importance of early educational interventions (Suwanbamrung et al., 2024).

However, the development of IMV as TAs remains limited due to the required advanced technological skills, financial resources, and time commitment from teachers. In response, the current study developed IMV-based TAs as an intervention tool for teaching about Aedes mosquitoes and the diseases they transmit. This tool was utilised during T&L sessions among Year Three primary school students. The study evaluated the effectiveness of this TA in improving students' understanding and knowledge regarding Aedes mosquitoes and associated diseases.

3.0 Methodology

3.1 Study location, sample size and sample selection

The experimental study was conducted in two purposively selected primary schools located in a dengue-endemic area of Hulu Langat, Selangor (approximate inter-school distance ≈ 8 km). Purposive school selection ensured administrative willingness and confirmed that both schools were within the same dengue cluster area to reduce contextual variation, although generalizability is limited. G*power software indicated 164 respondents were required for the minimum recommended sample size. To account for a 10% dropout rate, a total of 180 students were targeted (90 per school). Systematic random sampling was performed to select the sample from a list of names among the standard three students in each school. The study was conducted with 171 respondents, 82 in the control group and 89 in the intervention group.

3.2 Intervention (interactive multimedia video) and data collection procedures

The intervention utilised an IMV designed explicitly for Year Three students to cover Aedes mosquitoes and related diseases. The IMV session lasted one standard 30-minute class period. To manage cognitive load and enhance retention, the 12-minute core video was segmented into four short, three-minute sections, following principles from Mayer's CTML. The first episode addresses the biology of the Aedes mosquito, including its lifecycle and peak biting periods. The second episode explores mosquito-borne diseases, including dengue, chikungunya, and Zika, outlining their key signs and symptoms. The third episode identifies potential breeding sites and discusses environmental factors contributing to Aedes habitat suitability. The final episode presents integrated control and prevention strategies, including container cleaning, proper waste management, biological control using larvivorous fish, chemical control with larvicides and fogging operations conducted by authorised agencies.

After each episode, a short, four-to five-item checklist appeared as a knowledge check, which teachers facilitated a brief discussion around before proceeding. The teacher's role was primarily to guide the viewing and peer discussion. The control school received standard, teacher-led instruction on the same topic using the prescribed PJPK textbook during one 30-minute session. Knowledge was assessed using a pre-tested, structured questionnaire administered in Malay. This questionnaire comprised 55 multiple-choice questions (33 on Aedes mosquitoes and 22 on related diseases) in addition to demographic information. Measurement occurred at three key intervals: baseline (pre-test), immediately after the intervention (post-test), and three months post-intervention (follow-up) to evaluate retention.

3.3 Data analysis and ethics

Data analysis was performed using the IBM Statistical Package for Social Sciences (SPSS). We first generated knowledge scores by assigning one point for each correct answer and calculated descriptive statistics, including means, standard deviations, frequencies, and percentages. To compare the effectiveness of the two teaching methods (textbook vs. IMV) across the three measurement points (pre-test, post-test, and three-month follow-up), we employed a Mixed ANOVA test. The study protocol was approved by the Ethical Review Committee of the National University of Malaysia (Ethical code number NN-2017-091). We secured verbal consent from all participating school principals, obtained formal research permission from the Ministry of Education and relevant district offices, and acquired written consent from the school headmaster for student participation.

4.0 Findings

4.1 Descriptive analysis

Out of 180 students, nine (one from the intervention group and eight from the control group) did not present for post-intervention data collection and were excluded from the sample. The final sample size consisted of 171 participants, yielding a 95% response rate. Table 1 displays the characteristics of the respondents. A total of 87 respondents (50.9%) were male, with the majority of respondents (95.9%) identifying as Malay. Approximately 9.9% of respondents reported a history of dengue infection, and 20.5% had a family member with a similar history. Most respondents (74.3%) claimed they had never watched an animated video related to Aedes mosquitoes and vector-borne diseases.

Table 1. Demographic analysis of the respondents for the control group (n=82) and the intervention group (n=89)

Variables	Control group, n (%)	Intervention group, n (%)
Gender		
Male	40 (48.8)	47 (52.8)
Female	42 (51.2)	42 (47.2)
Ethnicity		
Malay	77 (93.9)	87 (97.8)
Non-Malay	5 (6.1)	2 (2.2)
History of dengue infection (before intervention)		
Self		
Yes	11 (13.4)	6 (6.7)
No	71 (86.6)	83 (93.3)
History of dengue infection (before intervention)		
Family members		
Yes	17 (20.7)	18 (20.2)
No	65 (79.3)	71 (79.8)
Have you ever watched any animated video related to Aedes mosquitoes (before intervention)		
Yes		
No	62 (75.6)	65 (73.0)
	20 (24.4)	24 (27.0)

4.2 Knowledge score

Knowledge scores for both groups before, immediately after, and three months post-intervention are shown in Table 2. Before the intervention, the mean score of the intervention group (36.66 ± 6.54) was slightly higher than that of the control group (31.63 ± 9.53), representing a difference of 5.03 points. Immediately after the intervention, this mean difference widened to 14.73 points, with the intervention group scoring significantly higher (49.80 ± 4.04 vs. 35.07 ± 9.71). At three months post-intervention, the control group's mean score increased slightly to 36.01, a 0.94-point gain from the post-test score. Conversely, the intervention group showed a 2.76 point drop in retention from the post-test score. Nevertheless, the overall mean knowledge score three months post-intervention in the intervention school remained higher than that of the control school, with a mean score difference of 11.03 points.

Table 2. Respondent's knowledge score before, after, and three months after the intervention

Group	Before the intervention, (Mean±SD	After the intervention, (Mean±SD	Three months after the intervention, (Mean±SD
Intervention	36.66 ± 6.54	49.80 ± 4.04	47.04 ± 4.67
Control	31.63 ± 9.53	35.07 ± 9.71	36.01 ± 9.32

4.3 Comparison of knowledge levels among respondent groups before, after, and three months following the intervention

A mixed ANOVA test was used to evaluate the main effects of the independent variable. Table 3 shows a significant main effect of time on knowledge scores, with Wilk's Lambda = 0.41, F(2, 168) = 122.23, p < 0.001. This indicates significant changes in knowledge scores across the three data collection time points, with a large effect size (partial eta-squared value of 0.59).

Table 3. Differences in knowledge scores across different time intervals

Effect	Value	*F*	*Hypothesis df*	*Error df*	*Partial Eta Squared*
Time *(Wilk's Lambda)*	0.41*	122.23	2.00	168.00	0.56

*p<0.001

Table 4 shows a significant Time*Group interaction effect on knowledge scores across the three time points (Wilk's Lambda = 0.69, F(2, 168) = 38.55, p < 0.001). The partial eta-squared value of 0.32 indicates a large effect size.

Table 4. Interaction effect between time and respondent group on knowledge scores

Effect	Value	*F*	*Hypothesis df*	*Error df*	*Partial Eta Squared*
Time*Group *(Wilk's Lambda)*	0.69*	38.55	2.00	168.00	0.32

*p<0.001

Table 5 presents the significant main between-subjects effect, comparing the control and intervention schools. The result, F(1, 169) = 106.87, p < 0.001, indicates a significant difference in knowledge scores between the intervention (IMV) and control (textbook) groups. The partial eta squared value of 0.39 indicates a large effect size, suggesting the effectiveness of the IMV intervention.

Table 5. Effects between subjects

Source	*df*	*Error df*	*F*	*Partial Eta Squared*
Group	1	169	106.87*	0.39

*p<0.001

5.0 Discussion

5.1 Formal Aedes education in Malaysia

Education is pivotal in curbing Aedes-borne viral diseases such as dengue fever. In Malaysia, the Ministry of Education (MOE) has proactively embedded foundational content on Aedes mosquitoes and dengue prevention within the primary school curriculum (Zaini et al., 2019a). Since 1993, Year Three pupils have received instruction on Aedes mosquitoes and dengue fever through the Physical and Health Education syllabus (Karimah Hanim et al., 2017). Given that these sessions (standard one, two, and three) are taught in the afternoon, students' mental, physical, and emotional factors must be considered when producing and using TAs to gain their complete attention during class. As a result, media-oriented TAs have been chosen as an alternative to gain students' attention regarding the learning topic as presented and discussed in this study.

5.2 Justification for using media as an educational tool

Classroom teaching and learning sessions are predominantly characterised by one-way communication from teachers to students. Even when two-way communication occurs, such interaction remains limited during the instructional delivery process. Integrating media as a TA, particularly for conveying information about Aedes mosquitoes and the diseases they transmit, can enhance the quality and frequency of two-way communication between teachers and students. Educational media supports teachers, especially those lacking confidence or familiarity with the subject matter, and provides opportunities to reinforce key concepts. Electronic multimedia, such as video, is a valuable tool for disseminating knowledge, and it has been proven to enhance the effectiveness of awareness campaigns (Zaini et al., 2019a).

A key practical concern with video-based instruction is cognitive overload, as well as determining the optimal length for student engagement. Previous research suggests that segmentation, signalling, and the careful combination of narration and graphics can reduce extraneous cognitive load and enhance learning outcomes (Mayer, 2024). In designing the interactive video used here, we applied these principles by dividing the content into three short segments (approximately two minutes each) with interspersed interactive checkpoints. This approach supports generative processing and engagement, consistent with findings that educational interventions using digital tools enhance attention and knowledge retention (Dapari et al., 2024).

5.3 Effectiveness of interactive multimedia as an educational tool

Numerous studies have highlighted the effectiveness of interactive multimedia as a TA, emphasising its ability to enhance the learning process through the simulation of sounds, graphics, diagrams, animations, and vivid imagery. These multimedia features significantly improve students' cognitive performance, interest, and behaviour, ultimately reinforcing understanding and academic achievement, particularly when utilising digital tools in health education (Dapari et al., 2024). The engaging nature of such instructional methods boosts student motivation and contributes to a more meaningful and enjoyable learning experience. This was demonstrated in a study by Othman and Raini (2011) in Brunei, which reported a statistically significant improvement in post-test reading performance among an average group of students who used an interactive computer application compared to their peers who were taught using traditional methods.

In the present study, an intervention was implemented for the treatment group by shifting the instructional approach from conventional textbook-based learning to IMV. However, contrasting evidence was reported by Martin and Martin (2015), who found that students were generally unwilling to engage with video tutorials that spanned more than three minutes. Additionally, relying solely on visual elements can overload the learner's cognitive capacity for visual processing, as both text and graphics compete for attention within the same modality (Clark et al., 2003).

5.4 Study limitations

Several limitations should be noted. First, schools were selected purposively; therefore, the findings may not be generalizable to all Malaysian primary schools, particularly those in very different socio-economic contexts. Second, follow-up was limited to three months; longer-term retention and behaviour change were not measured. Third, the evaluation focused on knowledge outcomes and did not directly assess changes in preventive practices or reductions in breeding sites at home that relate to behavioural outcomes which are ultimately important for dengue control. Fourth, there is potential for contamination (information sharing across schools), though the geographical separation and scheduling sought to minimise this risk. These limitations suggest caution in extrapolating the size or durability of effects beyond similar settings and timeframes.

6.0 Conclusion & Recommendations

This study demonstrates that a carefully designed IMV significantly improved knowledge about Aedes mosquitoes and related diseases among Year Three students immediately after intervention and retained higher knowledge at three months compared with traditional textbook instruction. The IMV's use of segmentation, brief interactivity, and narration, along with graphics, likely contributed to these effects.

For practice and policy, the MOE and school districts should consider pilot-scaling short IMV modules (featuring three to four segments per topic, with interactive checkpoints) within the PJPK curriculum, starting specifically in dengue-endemic districts. Furthermore, providing short teacher training modules on facilitating IMV sessions and on conducting the brief peer discussions that

enhance the video's effectiveness is essential. Finally, future curriculum pilots should include behavioural outcomes, such as household breeding site counts, to evaluate the effect on practices, not just knowledge.

For future research, it is recommended to conduct multi-site trials with longer follow-up (more than 12 months) to assess the durability of knowledge and translation into preventive practices. Studies should also compare different multimedia formats and interactivity levels (such as comparing IMV with embedded quizzes against IMV with hands-on activities) to identify the most cost-effective approach. Additionally, evaluating the feasibility and cost-effectiveness of integrating IMV modules into national health education programs is necessary. Attending to sound instructional design and teacher facilitation, short IMVs can serve as a practical and effective adjunct to textbook-based teaching for dengue education in primary schools.

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Paper Contribution to the Related Field of Study

This study demonstrates that the use of technology, specifically IMV, can have a positive impact on health education, particularly in helping the public understand Aedes mosquitoes and the diseases they transmit. While traditional materials such as textbooks remain important, interactive videos are a valuable addition, aligning with global trends in educational technology. These videos can help educate and empower communities to improve their quality of life and protect themselves from Aedes-borne diseases.

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