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HAND WASHING EDUCATION USING VIDEO ANIMATION TO ENHANCE KNOWLEDGE AND ATTITUDES AMONG SECONDARY SCHOOL STUDENTS: A QUASI-EXPERIMENTAL STUDY

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ABSTRACT
Hand hygiene represents a fundamental infection prevention strategy, particularly critical among adolescent populations who serve as potential vectors for respiratory and gastrointestinal disease transmission. This study aimed to evaluate the efficacy of animated video-based educational interventions on hand hygiene knowledge and attitudinal outcomes among junior high school students. A quasi-experimental pre-test/post-test design without control group was implemented among 109 seventh-grade students at one public Secondary High School (SHS) in Bantul, Indonesia. Convenience sampling was employed across five class sections. Participants received a structured educational intervention utilizing animated video content. Assessment was conducted via validated knowledge and attitude questionnaires administered before and after intervention. Statistical analysis employed the Wilcoxon signed-rank test to evaluate intervention effects. Participants (58.7% female, 41.3% male) demonstrated statistically significant improvement in hand hygiene knowledge scores following the intervention (pre-test mean=9.55±0.687; post-test mean=9.76±0.507; p=0.001). However, attitudinal measures did not show significant change (pre-test mean=30.68±4.86; post-test mean=31.35±4.76; p=0.160). Animated video-based educational interventions demonstrate significant efficacy in enhancing hand hygiene knowledge among secondary school students, though attitudinal changes appear more resistant to short-term intervention.

Keywords: adolescents; attitudes; hand hygiene; health education; knowledge; video animation

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INTRODUCTION

Hand hygiene represents a cornerstone of infectious disease prevention across global contexts. The Centers for Disease Control and Prevention (CDC) advocates a structured five-step handwashing protocol: wet, lather, scrub, rinse, and dry, with emphasis on a minimum 20-second duration for effective pathogen reduction (Lotfinejad et al., 2021). This seemingly simple practice has profound public health implications, with robust evidence suggesting appropriate hand hygiene can prevent approximately one-third of infectious disease transmission (Younie et al., 2020).

The global burden of healthcare-associated infections (HAIs) affects 7-10% of hospitalized patients worldwide, imposing substantial socioeconomic costs through extended hospitalization, increased healthcare expenditure, and diminished quality of care (Shaban et al., 2020). Following the World Health Organization's (WHO) landmark guidelines in 2009, numerous countries including the Republic of Korea have implemented national hand hygiene campaigns utilizing multifaceted approaches. Despite these initiatives, compliance rates remain suboptimal, typically ranging from 30-60% even among healthcare professionals, underscoring the complexity of behavioral modification in this domain (Chun et al., 2016).

Educational institutions, particularly schools, represent critical venues for hand hygiene promotion. The Centers for Disease Control and Prevention has established comprehensive guidelines for Child Care Centers (ECCs), emphasizing handwashing protocols for all students, educators, and support personnel (Clark et al., 2016; McMichael, 2019). These institutional settings not only serve to implement hygiene practices directly but function as knowledge dissemination centers influencing broader community behaviors. This educational component has gained further significance during the COVID-19 pandemic, with non-pharmaceutical interventions including hand hygiene becoming essential public health strategies (Younie et al., 2020).

The Sustainable Development Goals (SDGs) explicitly address water, sanitation, and hygiene (WASH) infrastructure in educational settings. Target 4.a specifically identifies indicators including "proportion of schools with access to basic handwashing facilities" as benchmark metrics (McMichael, 2019). This integration of hand hygiene into global development frameworks reflects recognition of its impact beyond immediate health outcomes to include educational attendance, behavioral modification, and broader public health metrics.

Contemporary health education increasingly employs multimedia approaches to enhance engagement and knowledge retention. Video-based interventions represent a particularly effective modality for school-based health promotion due to their integration of visual, auditory, and movement elements (N. A. Mohamed et al., 2020). This multimodal approach appears particularly suited to hand hygiene education, with several studies documenting significant improvements in correct handwashing technique following video-based interventions (N. A. Mohamed et al., 2020).

Despite widespread recognition of hand hygiene importance, implementation remains suboptimal across diverse populations. Recent systematic review showed barriers to hand hygiene adherence among healthcare are complex including behavioural, societal/interpersonal, physical, and organizational barriers (Afework & Tamene, 2025). These concerning highlight the persistent gap between knowledge and practice, emphasizing the need for innovative educational approaches to translate understanding into behavioral change. While most research focuses on critical moments for handwashing, including before eating (93% self-reported compliance) and after toilet use (92% self-reported compliance), notable discrepancies exist between self-reported and observed behaviors (Ashraf et al., 2020). This observation-reporting gap reinforces the need for interventions focused not only on knowledge acquisition but sustainable behavioral modification.

The Indonesian context presents multifaceted challenges in hand hygiene promotion, categorized into infrastructural, behavioral, and educational barriers. Infrastructural challenges include persistent water scarcity in rural healthcare facilities, which directly compromises handwashing capability (Kusumaningtiar et al., 2024). Educational institutions frequently demonstrate insufficient handwashing facilities; specifically, schools in Bekasi City lack adequate soap and water stations, substantially hindering hygiene promotion efforts among students (Kusumaningtiar et al., 2024). Further exacerbating these issues, urban centers such as Banjarmasin exhibit deficient waste management and wastewater disposal systems that undermine hygienic practice implementation (Juanda et al., 2025).

Behavioral determinants constitute equally significant obstacles within Indonesia. Risk perception significantly moderates hygiene behaviors, with elevated compliance documented during the COVID-19 pandemic among individuals perceiving increased infection susceptibility (Dwipayanti et al., 2021). Educational challenges persist despite intervention efforts; while structured programs demonstrate significant improvements in knowledge and practices among healthcare workers, these gains often diminish over time, necessitating sustained educational initiatives (Saharman et al., 2019; Tjoa et al., 2022). School-based programs, including the Fit for School (FIT) initiative featuring daily group handwashing, have demonstrated positive outcomes but require consistent

implementation resources for sustainable impact (Duijster et al., 2017). These multidimensional challenges underscore the urgency of developing contextually appropriate, evidence-based hand hygiene interventions for Indonesian populations.

The present study addresses a critical research gap by examining the efficacy of animated video-based educational interventions on hand hygiene knowledge and attitudes among Indonesian secondary school students. By targeting this developmental period when health behaviors are being established, the intervention aims to promote practices that may persist into adulthood, thereby contributing to broader public health objectives. The specific aim was to analyze the effectiveness of animated video-based hand hygiene education in enhancing knowledge and attitudes among seventh-grade students.

METHOD

Research Design

This study employed a quasi-experimental pre-test/post-test design without control group to evaluate the impact of animated video-based education on hand hygiene knowledge and attitudes. This methodological approach was selected due to administrative constraints precluding randomization within the educational setting. The design allowed for measurement of intervention effects through comparison of pre-intervention and post-intervention outcomes within the same participant cohort.

Population and Sample

The target population comprised seventh-grade students at one public Secondary High School (SHS) in Bantul, Indonesia. This demographic was selected based on developmental appropriateness for hand hygiene education and the critical period for establishing health behaviors during early adolescence. Inclusion criteria encompassed: (1) official enrollment as a seventh-grade student at SMP Negeri 2 Banguntapan Bantul; (2) presence during both pre-test and post-test assessments; (3) parental/guardian informed consent; and (4) personal assent to participate. Exclusion criteria included: (1) cognitive impairment precluding questionnaire comprehension; (2) absence during either assessment period; and (3) withdrawal of consent/assent at any point during the study.

Sample size calculation utilized G*Power 3.1 software with parameters specified as follows: test family = t-tests; statistical test = means difference between two dependent means (matched pairs); effect size $|d| = 0.3$ (small to medium effect based on previous similar interventions); $\alpha = 0.05$; power $(1-\beta) = 0.80$; allocation ratio = 1 (Faul et al., 2009). This calculation yielded a required sample size of 90 participants. Accounting for potential attrition (20%), the target recruitment was established at 108 participants, with final enrollment of 109 students. Convenience sampling was employed across five class sections (Classes 7A-7E), with the distribution as follows: Class 7A (n=24, 22.0%), Class 7B (n=24, 22.0%), Class 7C (n=24, 22.0%), Class 7D (n=17, 15.6%), and Class 7E (n=20, 18.3%). This sampling approach was necessitated by administrative constraints and the intact classroom structure within the educational setting.

Research Instruments

Two structured questionnaires addressing hand hygiene knowledge and attitudes were developed through a systematic process. Initial item pools were generated through comprehensive literature review of peer-reviewed publications addressing hand hygiene knowledge and behavioral determinants (Hong & Xu, 2024; Y. S. Mohamed et al., 2024; Ntaote et al., 2024; Srigley et al., 2020). The theoretical framework incorporated elements from the Health Belief Model (Rosenstock, 1974) and Theory of Planned Behavior (Ajzen, 1991) constructs including perceived susceptibility, perceived severity, perceived barriers, perceived benefits, cues to action, and behavioral intention.

The knowledge questionnaire comprised 10 items addressing procedural aspects of hand hygiene, critical moments for implementation, and microbial transmission concepts. The attitude questionnaire similarly contained 10 items assessing affective components related to hand hygiene implementation, perceived importance, and contextual facilitators/barriers. Each knowledge item utilized a binary correct/incorrect response format, while attitudinal items employed a 5-point Likert scale (1=strongly disagree to 5=strongly agree).

Instrument validation employed a two-stage process. Content validity was established through expert panel review comprising three infection control specialists and two health education specialists. The Content Validity Index (CVI) was calculated at the item level (I-CVI) and scale level (S-CVI), with threshold acceptance criteria of ≥0.78 and ≥0.90 (Polit et al., 2007; Polit & Beck, 2006). Construct validity was evaluated through pilot testing with 30 seventh-grade students from a comparable school not participating in the main study. Exploratory factor analysis (EFA) utilizing principal component analysis with varimax rotation was conducted to assess internal structure. Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (≥0.70) and Bartlett's test of sphericity ($p<0.05$) confirmed data suitability for factor analysis. Items with factor loadings <0.40 or cross-loadings >0.30 were eliminated or revised. Reliability assessment employed Cronbach's alpha for internal consistency, with minimum threshold of $\alpha \geq 0.70$ for acceptable reliability. Test-retest reliability was evaluated using intraclass correlation coefficient (ICC) with two-week interval between administrations (acceptable threshold: ICC≥0.70). The final knowledge instrument demonstrated S-CVI=0.92, Cronbach's $\alpha=0.83$, and ICC=0.85. The attitude instrument demonstrated S-CVI=0.90, Cronbach's $\alpha=0.78$, and ICC=0.81, confirming adequate psychometric properties for both instruments.

Intervention Protocol

The educational intervention utilized an animated video addressing hand hygiene principles and practices. The content was developed through collaborative efforts between infection control specialists, health education experts, and digital media designers to ensure scientific accuracy, developmental appropriateness, and engagement potential. The video content encompassed five core elements: (1) microbial transmission pathways; (2) disease consequences of inadequate hand hygiene; (3) critical moments for handwashing implementation; (4) step-by-step demonstration of proper handwashing technique following WHO guidelines; and (5) practical implementation strategies addressing common barriers. The animation incorporated age-appropriate characters, contextually relevant scenarios, and evidence-based behavioral change techniques including demonstration, modeling, and implementation intention formation.

The final video selection prioritized: (1) evidence-based content accuracy; (2) cultural appropriateness for Indonesian adolescents; (3) engagement potential through narrative structure; (4) optimal duration (8-10 minutes) based on attention span considerations; and (5) technical quality including visual clarity, sound fidelity, and seamless animation transitions. Multiple candidate videos were evaluated against these criteria, with the highest-scoring content selected for implementation. The video intervention was administered collectively in classroom settings using standardized digital projection equipment with appropriate audio capabilities. Prior to video presentation, a brief introduction (approximately 2 minutes) contextualized the content importance. Following video presentation, a 5-minute structured reflection period facilitated integration of key concepts.

Data Collection Procedure

The research was conducted in February 2022 over approximately one week. Data collection occurred in classroom settings during regular school hours to minimize disruption to educational activities. Pre-test assessment was conducted on Day 1, video intervention on Day 2, and post-test assessment on Day 7, allowing for cognitive processing and potential behavioral intention

formation. Data collection was conducted by a team comprising the principal investigator and three research assistants with nursing education backgrounds. All research personnel completed standardized training addressing questionnaire administration, ethical considerations, and intervention fidelity assurance. Inter-rater reliability was established through pilot administration with $\kappa \geq 0.80$ for procedural consistency. Questionnaires were administered in classroom settings with privacy safeguards including adequate spacing between participants and prohibition of peer consultation. Each participant received a unique identification code to facilitate paired analysis while preserving anonymity. Completed questionnaires were immediately secured in opaque, sealed envelopes and transported to secured storage within the research institution.

Ethical Considerations

Ethical approval was obtained from the Ethics Committee of the Faculty of Medicine, Muhammadiyah University of Yogyakarta (No. 158/EC-KEPK FKIK UMY/III/2023). The research protocol adhered to principles outlined in the Declaration of Helsinki regarding human subjects research. Informed consent was obtained from parents/guardians, with additional assent from student participants. Participation was voluntary with explicit provisions for withdrawal without penalty. Confidentiality was maintained through anonymized data collection and secure data management protocols.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics (Version 25.0, IBM Corp., Armonk, NY). Descriptive statistics characterized the study population and outcome variables. Categorical variables (gender, class section) were summarized using frequencies and percentages. Paired difference scores (post-test minus pre-test) for knowledge and attitudes were evaluated for normality using Shapiro-Wilk test. Results indicated non-normal distribution for knowledge difference scores ($W=0.892$, $p<0.001$) and borderline normality for attitude difference scores ($W=0.972$, $p=0.047$), necessitating non-parametric analytical approaches. The primary analysis employed the Wilcoxon signed-rank test to evaluate differences between pre-test and post-test scores for both knowledge and attitudes. This non-parametric approach was selected based on violation of normality assumptions for paired differences and the ordinal nature of Likert-scale data in the attitude questionnaire. Statistical significance was established at $\alpha=0.05$ (two-tailed).

RESULT

Participant Demographics

The study enrolled 109 participants, with gender distribution of 64 females (58.7%) and 45 males (41.3%). All participants were seventh-grade students distributed across five class sections as detailed in the methodology (Table 1).

Table 1.
Respondents Characteristics (n=109)

Variable	Category	f	%
Gender	Male	45	41.3
	Female	64	58.7
Class room section	Class 7A	24	22.0
	Class 7B	24	22.0
	Class 7C	24	22.0
	Class 7D	17	15.6
	Class 7E	20	18.3

Knowledge Assessment Outcomes

Analysis of hand hygiene knowledge scores revealed statistically significant improvement following the educational intervention (Table 3). Pre-test knowledge scores averaged 9.55±0.687, increasing to 9.76±0.507 post-intervention ($p=0.001$).

Table 2.
Hand Hygiene Knowledge Assessment Outcomes

Assessment	n	Mean	SD	p-value	Effect size (r)
Pre-test knowledge	109	9.55	0.687	0.001*	0.32
Post-test knowledge	109	9.76	0.507		

*Statistically significant at $p<0.05$ (Wilcoxon signed-rank test)

Attitudinal Assessment Outcomes

Analysis of hand hygiene attitudes did not demonstrate statistically significant change following the intervention (Table 4). Pre-test attitudinal scores averaged 30.68±4.86, with post-test scores of 31.35±4.76 ($p=0.160$).

Table 3.
Hand Hygiene Attitudinal Assessment Outcomes

Assessment	n	Mean	SD	p-value	Effect size (r)
Pre-test attitude	109	30.68	4.86	0.160	0.14
Post-test attitude	109	31.35	4.76		

Note: Wilcoxon signed-rank test was performed

DISCUSSION

This quasi-experimental study evaluated the efficacy of animated video-based educational interventions on hand hygiene knowledge and attitudes among Indonesian secondary school students. The results demonstrated statistically significant improvement in knowledge scores ($p=0.001$) but non-significant changes in attitudinal measures ($p=0.160$), suggesting differential intervention effects across cognitive and affective domains. The significant enhancement in knowledge scores aligns with previous research documenting the effectiveness of video-based educational approaches in school settings. Previous studies identified video animations as valuable supplements to hand hygiene curricula, noting their capacity to present information in developmentally appropriate formats (Rittenschober-Böhm et al., 2024). The inherent characteristics of video-based content—combining visual, auditory, and movement elements—appear particularly conducive to knowledge acquisition among school-aged populations. This medium facilitates improved comprehension of complex procedural information, such as the sequential steps in proper handwashing technique.

The role of educational entertainment (EE) in health promotion represents a growing area of interest, with Grady et al. (2021) identifying several studies examining instructional videos addressing health-related topics (Grady et al., 2021). This approach integrates educational content within engaging formats designed to promote behavioral change, often utilizing audio-visual media as the primary delivery mechanism. The present study's findings support the utility of this approach in enhancing knowledge acquisition, though its impact on attitudinal change appears more limited. The specificity of handwashing as a procedural skill may partially explain the intervention's effectiveness regarding knowledge outcomes. As described by previous studies, handwashing involves sequential actions progressing from fingertips to elbows, utilizing specific techniques to maximize pathogen removal (Rittenschober-Böhm et al., 2024). The visual demonstration facilitated by video animation allows learners to observe and internalize these procedures more effectively than text-based instruction alone. This procedural clarity may contribute to the significant improvement in knowledge scores observed in this study (Isse et al., 2024; Rittenschober-Böhm et al., 2024).

The contrasting non-significant results regarding attitudinal change merit careful consideration. Attitudes toward health behaviors typically involve complex affective components shaped by multiple influences including social norms, perceived vulnerability, and self-efficacy beliefs.

Previous studies also documented the persistence of a knowledge-practice gap in hand hygiene behaviors, noting that healthcare professionals often demonstrate adequate knowledge and positive attitudes but inconsistent implementation (Li et al., 2019). This suggests that while knowledge is necessary for behavioral change, it remains insufficient without addressing broader contextual factors.

Implementation barriers identified in previous research may also contribute to the limited attitudinal impact observed. Previous study documented improvement in hand hygiene compliance following a playful intervention with children and caregivers, but noted persistent barriers including insufficient resources and high student-to-teacher ratios (Suen & Cheung, 2020). These practical constraints may influence attitudes toward hand hygiene implementation despite enhanced knowledge of proper techniques. The medium of animated video appears particularly suited to certain types of health communication. A previous study noted that animation's effectiveness likely varies based on content type, with simple illustrations of procedural processes demonstrating greater impact than more complex content addressing informed consent or abstract concepts (Rittenschober-Böhm et al., 2024). This observation aligns with our findings of significant knowledge enhancement but limited attitudinal change, as procedural knowledge may be more readily conveyed through visual demonstration than affective components influencing attitudes (Buchner, 2018).

This study findings contributes substantive evidence to the growing body of literature on multimedia-based hygiene education interventions among adolescent populations. The differential impact observed significant enhancement of knowledge metrics alongside non-significant attitudinal modification underscores the complex, multidimensional nature of health behavior modification. This pattern aligns with contemporary theoretical frameworks suggesting that while procedural knowledge represents a necessary precondition for behavioral change, it remains insufficient without corresponding modifications to affective determinants, social normative perceptions, and environmental facilitators.

Limitations

Several limitations warrant acknowledgment. The absence of a control group limits causal inference regarding intervention effects. The relatively short follow-up period precludes assessment of knowledge retention and potential delayed attitudinal change. The high baseline knowledge scores (pre-test mean=9.55±0.687 out of 10) suggest potential ceiling effects limiting observable improvement. Future research should address these limitations through randomized controlled designs with extended follow-up periods and more sensitive assessment instruments.

Implication

Educational practitioners should consider incorporating animated video content into hand hygiene curricula to enhance knowledge acquisition while recognizing the need for supplementary approaches to address attitudinal components. Public health initiatives should develop integrated interventions combining procedural education with strategies addressing social norms and implementation barriers. Healthcare educators should acknowledge the persistent knowledge-practice gap and develop targeted interventions to translate enhanced knowledge into consistent implementation.

CONCLUSION

Postpartum Exercise and music therapy can reduce anxiety in postpartum mothers

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