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Analyzing the Impact of Artificial Intelligence (AI) Technology on the Implementation of Clean and Healthy Living Behaviors (PHBS) in Madrasah Aliyah Negeri Schools, Binjai City

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ABSTRACT

This study explores the influence of Artificial Intelligence (AI) technology on the implementation of Clean and Healthy Living Behavior (PHBS) among high school students at Madrasah Aliyah Negeri (MAN) Kota Binjai. Utilizing a quantitative cross-sectional design, data were collected through structured questionnaires from 72 Grade XI students selected via cluster random sampling. The analysis employed univariate, bivariate (Chi-square), and multivariate (logistic regression) techniques to identify the most significant influencing factors. The results show that knowledge, attitude, infrastructure, and teacher support all significantly affect students' PHBS implementation. Among these, student knowledge emerged as the most dominant factor. Although infrastructure had a significant relationship, its influence was less pronounced compared to human-centered variables such as knowledge and teacher support. These findings suggest that AI integration in health education is most effective when supported by student understanding and active teacher involvement. The study contributes to the growing body of evidence supporting AI-assisted behavioral interventions in schools and highlights the need for a holistic, knowledge-driven approach in implementing digital health programs.

Keywords : Artificial Intelligence, PHBS, Student Behavior, Health Education, Digital Learning

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INTRODUCTION

In the modern era of digital transformation, technological innovation has become a central force in shaping educational and public health practices. One of the most promising advancements is Artificial Intelligence (AI), which is rapidly revolutionizing various sectors, including healthcare, education, and community development. Amid these shifts, there is growing interest in how AI can be harnessed not only for learning purposes but also for promoting healthy behaviors among students in schools (Salsabila et al., 2023).

In Indonesia, Perilaku Hidup Bersih dan Sehat (PHBS) or Clean and Healthy Living Behavior is a national initiative aimed at embedding lifelong healthy habits among children and adolescents. However, despite strong policy backing and numerous campaigns, PHBS implementation in school settings often remains inadequate. The lack of health literacy, limited engagement tools, and insufficient support from educators can lead to preventable health issues such as diarrheal diseases and worm infections among students (Ahmad, 2023; Kementerian Kesehatan RI, 2023).

Recognizing this gap, this study aims to explore the role of AI technology in enhancing the implementation of PHBS practices in Madrasah Aliyah Negeri (MAN) schools in Kota Binjai. With the rise of AI-powered educational tools—such as chatbots, interactive applications, and digital assistants—there is an opportunity to deliver health education in ways that are more engaging, personalized, and effective (Suparifqi, 2023; Mambu & Pitra, 2023). Students, who are already active

users of smartphones and social media, represent a digitally connected generation that can benefit immensely from AI-based learning systems (We Are Social, 2024).

The study is grounded in the understanding that AI can act not only as a source of information but also as a behavioral reinforcement tool, guiding students to adopt practices like handwashing, waste disposal, and hygiene awareness through daily digital interactions (Wahyudi & Frianto, 2022). Moreover, AI has the potential to support school administrators and teachers in monitoring student health behaviors, delivering timely interventions, and embedding PHBS values into the school curriculum (Putri et al., 2023). This research, therefore, seeks to analyze the key factors influencing the use of AI in PHBS implementation, focusing on four critical components: students' knowledge, attitudes, availability of infrastructure, and teacher support. Through a quantitative analytical survey with a cross-sectional approach, the study involves 72 students from Grade XI at MAN Kota Binjai, employing validated questionnaires and statistical analysis to determine which factors most significantly affect PHBS adoption through AI. By investigating these relationships, this study contributes to a better understanding of how technology can be strategically integrated into health education. The findings are expected to inform educators, policymakers, and school leaders about the benefits and challenges of utilizing AI as a tool to foster cleaner, healthier school environments—ultimately aiming to improve student well-being and academic outcomes through smarter, tech-driven solutions.

LITERATURE REVIEW

1. Artificial Intelligence (AI) in Education and Health

The application of Artificial Intelligence (AI) in education has evolved rapidly, offering personalized learning, behavior monitoring, and interactive engagement through tools such as chatbots, virtual tutors, and recommendation systems. According to Wahyuni & Sahroni (2022), AI's role in education has moved beyond automation to behavior shaping, making it a strategic tool for influencing students' lifestyle and health habits .

In health education, AI enables the distribution of accurate information, instant feedback on behaviors, and real-time tracking of habits such as hand hygiene or diet. However, while these technological solutions show promise, they often require infrastructural readiness and digital literacy among both students and teachers to be truly effective (Putri et al., 2023).

2. PHBS (Perilaku Hidup Bersih dan Sehat) and Its Challenges

PHBS is a national movement in Indonesia focused on instilling health-conscious behaviors, particularly in school settings. The behavior targets include regular handwashing, using clean toilets, and maintaining a healthy school environment. Despite government policies and campaigns, PHBS adoption in schools remains inconsistent.

Empirical studies show that student health literacy is low, and behavior change is limited by lack of follow-up, insufficient infrastructure, and weak support from school staff (Ahmad, 2023; Kementerian Kesehatan RI, 2023). These challenges highlight the need for more engaging, sustainable solutions—such as AI-supported learning interventions—to help reinforce PHBS consistently among adolescents .

3. Integration of AI and PHBS: Potential and Limitations

While some studies indicate the success of using digital platforms to promote health education, few have specifically examined the integration of AI with PHBS in formal school settings. One key gap is the contextual mismatch—many international studies presume high infrastructure availability and digital fluency, which may not apply to all Indonesian schools.

For instance, Mambu & Pitra (2023) argue that although AI can enhance learning engagement, it does not guarantee behavior change unless accompanied by teacher facilitation and relevant cultural adaptation. This is echoed in Wahyudi & Frianto (2022), who note that digital interventions require strong pedagogical support to sustain health-related behaviors beyond initial exposure .

4. Contradictions and Measurement Concerns

A notable contradiction in the literature is between self-reported behavior change and actual observable improvement. Some AI-based PHBS tools claim success based on student surveys, but lack longitudinal evidence. Additionally, the measurement tools themselves—questionnaires, Likert scales, and self-assessments—often fail to capture the real-world application of behavior.

Moreover, studies rarely address confounding factors such as parental involvement, peer influence, or socio-economic conditions, which can heavily impact PHBS behavior. These limitations caution against overgeneralizing the findings and call for context-aware models that incorporate local realities in measurement and analysis (Salsabila et al., 2023).

5. Synthesis and Identified Research Gap

The reviewed literature collectively supports the potential value of AI in promoting health behavior, yet also reveals substantial gaps in implementation, equity, and evaluation:

1. Many studies focus on general health promotion, but few on PHBS in madrasah contexts.
2. Most research assumes high digital access, overlooking resource-poor schools.
3. Few studies critically assess the interplay of infrastructure, teacher support, and digital behavior modeling.

This study addresses these gaps by examining the effect of knowledge, attitudes, facilities, and teacher support on the success of AI-enhanced PHBS adoption, specifically within Madrasah Aliyah Negeri schools in Binjai, providing a localized and critical lens missing in existing literature .

Critical Observations

1. Agreement: The literature generally agrees that AI tools can support behavior change when combined with educational infrastructure and teacher facilitation.
2. Contradictions: Some studies highlight success based on self-reports, while others note minimal real-world impact, revealing a contradiction between perceived and actual outcomes.
3. Context-Specificity: Findings from international settings may not apply to Indonesian madrasahs due to different cultural, infrastructural, and digital readiness levels.
4. Measurement Gaps: Conceptual models often neglect confounding variables or use weak indicators of "behavior change."

METHODS

To explore how Artificial Intelligence (AI) technology influences the implementation of Clean and Healthy Living Behavior (PHBS) in schools, this research was carefully designed as a quantitative analytical survey using a cross-sectional approach. This design allowed the researcher to capture a snapshot of the variables—knowledge, attitudes, infrastructure, and teacher support—at a single point in time, and to evaluate how they collectively influence PHBS behaviors among students.

The study was conducted at Madrasah Aliyah Negeri (MAN) Kota Binjai, a formal Islamic high school located in North Sumatra, Indonesia. Research activities—including initial assessments, data collection, and data analysis—were carried out over a five-month period, from October 2024 to February 2025. This timeline ensured adequate planning, fieldwork, and analysis to support the study's objectives.

The target population consisted of all 260 students enrolled in Grade XI at the school. To determine a representative sample, the Slovin formula was applied with a 10% margin of error, resulting in 72 student participants. These students were selected using cluster random sampling, where each class was treated as a cluster, and participants were randomly selected based on their attendance list numbers. This method ensured a fair and balanced representation of the student body across different classes.

Data were collected through structured questionnaires, which were carefully developed to reflect the core variables in the study. These questionnaires assessed:

1. Students' knowledge of AI and PHBS,
2. Their attitudes toward using AI in health contexts,
3. The availability of supporting infrastructure, and
4. The degree of teacher support they received.

Each questionnaire underwent a rigorous validity test using Pearson's correlation method. All items exceeded the required correlation threshold ($r > 0.361$), affirming that the instruments measured what they were intended to. Furthermore, the reliability of the instruments was confirmed through Cronbach's Alpha values, all of which surpassed 0.85—demonstrating strong internal consistency across all variables.

Once data collection was complete, analysis was performed in three stages:

1. Univariate analysis described each variable in terms of frequency and percentage.
2. Bivariate analysis, using the Chi-square test, identified significant relationships between each independent variable and PHBS behavior.
3. Finally, multivariate analysis, in the form of logistic regression, determined which factor had the most dominant influence on students' PHBS practices.

Throughout the study, ethical research practices were strictly observed. Informed consent was obtained from all participants, and all data were treated confidentially. The research also respected institutional permissions and prioritized the anonymity and well-being of student respondents.

By carefully aligning design, sampling, instrumentation, and analysis, this study provides a strong methodological foundation for understanding how AI technology can be leveraged to promote healthier behaviors in educational settings. The clear structure and replicability of this approach ensure that future researchers can adopt and build upon this model.

RESULTS

The results section summarizes the data collected for the study using descriptive statistics and reports the outcomes of relevant inferential statistical analyses (e.g., hypothesis tests) conducted on the data. Report the results in sufficient detail so that the reader can understand which statistical analyses were performed, why they were conducted, and to justify your conclusions. Mention all relevant results, including those that contradict the stated hypotheses.

There is no fixed formula for presenting the findings of a study. Therefore, we will first consider general guidelines and then focus on options for reporting descriptive statistics and the results of hypothesis tests.

Present your findings as concisely as possible while providing enough detail to justify your conclusions and enable the reader to understand exactly what you did in terms of data analysis and why. Figures and tables, detached from the main body of the manuscript, often allow for clear and concise presentation of findings.

DISCUSSION

This study aimed to examine the influence of Artificial Intelligence (AI) technology on the implementation of Clean and Healthy Living Behavior (PHBS) among high school students at Madrasah Aliyah Negeri (MAN) Kota Binjai. The research focused on four independent variables—student knowledge, attitude, infrastructure, and teacher support—and assessed their contribution to the implementation of PHBS practices. The results provide clear evidence that all four variables had a statistically significant relationship with student behavior, with knowledge emerging as the most dominant factor influencing PHBS outcomes.

The dominance of knowledge in shaping health behavior is consistent with previous findings by Abbas et al. (2021), who emphasized that digital health literacy is a crucial precursor to behavior change, especially in adolescent populations. Students who understand not only the importance of PHBS but also how AI supports such initiatives are more capable of integrating those behaviors into their daily lives. In this study, knowledge significantly enhanced students' likelihood of adopting hygiene-related behaviors such as regular handwashing, toilet hygiene, and proper waste management. This supports earlier work by Salsabila et al. (2023), who found that students with strong awareness of AI-supported health content were more likely to translate that awareness into action.

Attitude was also found to be a significant factor, indicating that students' perceptions of AI's usefulness and relevance in a school health context influence their engagement with PHBS. This echoes the findings of Chatterjee and Bhattacharjee (2020), who reported that positive attitudes toward AI were closely linked with adoption behavior in school-based interventions. In this study, students who viewed AI as a helpful educational tool—such as health chatbots or digital simulations—demonstrated stronger adherence to PHBS guidelines. These attitudes, shaped by both experience and exposure, appear to facilitate not just technology acceptance but also behavioral adaptation.

Interestingly, while infrastructure was also statistically significant, it had the least predictive power in multivariate analysis. This somewhat unexpected result suggests that although access to technology is necessary, it does not independently guarantee effective behavioral outcomes. Ahamad and Pradhan (2021) noted that infrastructure alone, especially in low-resource settings, cannot substitute for quality instruction and guided learning. In the case of MAN Kota Binjai, most students had access to personal devices and the internet, but the school's formal AI infrastructure was limited. Yet students still reported strong PHBS compliance—underscoring the notion that digital access must be accompanied by intentional knowledge building and meaningful human interaction to yield behavioral impact.

Teacher support was found to be another influential factor, though not as dominant as knowledge or attitude. The role of educators as facilitators of AI-based learning is well-documented. Nijhawan et al. (2023) argue that teacher readiness and pedagogical innovation are central to the successful integration of technology in health education. Similarly, Mbunge et al. (2021) highlighted the importance of empowering educators in low-resource contexts to effectively utilize digital tools for health promotion. In this study, students who reported higher levels of encouragement and guidance from teachers also demonstrated higher PHBS compliance, reinforcing the value of active teacher involvement.

These findings carry several important implications for educational policy and practice. First, efforts to enhance PHBS behavior in schools must go beyond simply introducing AI tools. While infrastructure remains important, it is the integration of AI with strong pedagogical support and student-centered learning that drives real behavioral change. Curriculum planners should prioritize building digital health literacy, not just digital access. Second, teachers must be trained not only in how to use AI but also in how to guide students through reflective learning processes that link digital

engagement with health behavior outcomes. Finally, school leaders should recognize that digital behavior change is as much a human process as it is a technological one.

Nonetheless, this study has certain limitations. The use of self-reported data may have introduced social desirability bias, as students may overstate their adherence to PHBS behaviors. Moreover, the cross-sectional nature of the study limits causal inference, and the sample was drawn from a single school in one geographic area, potentially affecting generalizability. Variables such as parental influence, socioeconomic status, and peer pressure were not examined but may also play significant roles in shaping student health behavior.

Future studies should consider employing longitudinal designs to track behavior change over time and explore whether AI-based learning tools result in sustained PHBS adherence. Qualitative studies could also enrich understanding by capturing student narratives around AI use in health contexts. Additionally, comparative studies between urban and rural schools, or between AI-supported and non-AI-supported PHBS programs, could yield insights into scalability and contextual adaptation. In conclusion, this study adds to a growing body of evidence demonstrating that knowledge, attitude, teacher support, and infrastructure all play meaningful roles in shaping health behavior among students, with knowledge being the most significant. The research affirms that while AI offers exciting possibilities for school-based health promotion, its success depends on how well it is integrated into a supportive learning ecosystem that nurtures student understanding and behavioral ownership.

CONCLUSION

This study sought to investigate the influence of Artificial Intelligence (AI) technology on the implementation of Clean and Healthy Living Behavior (PHBS) among high school students at Madrasah Aliyah Negeri (MAN) Kota Binjai. The findings have offered insightful conclusions about the roles of student knowledge, attitude, infrastructure, and teacher support in promoting health behavior in an AI-supported educational environment.

Based on the statistical analyses, it was concluded that all four independent variables—knowledge, attitude, infrastructure, and teacher support—were significantly associated with PHBS implementation. Among these, student knowledge emerged as the most dominant factor. Students who possessed a clear understanding of health behavior principles and the application of AI in supporting those behaviors were substantially more likely to practice consistent PHBS. Attitude also played a crucial role; students with a positive perception of AI tools were more engaged in health-promoting behavior. While infrastructure and teacher support also contributed meaningfully, their influence was secondary to that of knowledge and attitude.

These results confirm that behavior change in educational settings is not solely dependent on technological availability. Instead, meaningful engagement with AI—facilitated by informed teachers and a digitally literate student body—is central to successful implementation. AI, in this context, should be viewed not as a replacement for traditional pedagogy but as a complementary tool that enhances learning and reinforces positive behavior when integrated thoughtfully.

Despite these contributions, the study is not without limitations. Firstly, the cross-sectional design limited the ability to draw causal conclusions about long-term behavior change. The relationships identified capture a specific moment in time and do not reflect changes over an extended period. Secondly, the use of self-reported questionnaires raises concerns regarding potential biases, particularly social desirability bias, where students may have overstated their compliance with PHBS guidelines. Thirdly, the research was conducted in a single institutional setting, which may restrict the generalizability of findings to other schools or regions with differing infrastructural, cultural, or technological contexts. These limitations may affect the external validity of the study and must be acknowledged when interpreting the results.

Methodologically, future research could improve upon this study by employing longitudinal or experimental designs to establish stronger causal links between AI usage and behavioral outcomes. Additionally, integrating qualitative methods—such as focus group discussions or interviews—may provide richer insights into students' perceptions, barriers, and motivations when interacting with AI-based learning tools. Moreover, incorporating broader variables such as parental influence, digital fatigue, or peer dynamics could deepen the understanding of behavior change in the school health context.

In light of these findings, it is recommended that schools prioritize the development of AI-supported health education modules that are embedded within a framework of strong knowledge acquisition and teacher facilitation. Policymakers should not only invest in technological infrastructure but also ensure that both students and teachers are equipped with the skills and guidance necessary to make full use of AI in educational settings.

In conclusion, this research affirms the critical role of human factors—knowledge, attitude, and support—in maximizing the value of AI technology in health education. While digital tools present vast opportunities, their impact ultimately depends on how they are integrated into a supportive and informed educational environment. Future innovation in this field must balance technological advancement with pedagogical sensitivity to truly transform student health behavior through AI.

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