# SmartHealth a Web-Based Platform for Adolescent Health Education with User Testing

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**Abstract - Adolescents in Indonesia continue to face barriers in accessing accurate, engaging, and relevant health education, while digital health literacy remains uneven. This study aims to develop and evaluate SmartHealth, a web-based adolescent health education platform, using an integrated theoretical framework combining the Technology Acceptance Model, Health Belief Model, Theory of Planned Behavior, and the Digital Health Literacy Model. The research employs a Research and Development approach that integrates the Borg and Gall model with the Waterfall software development method across four stages: need assessment, product design, system development, and limited field testing. A total of 60 high school students participated in usability testing using the System Usability Scale. The results show that SmartHealth achieved a mean usability score of 78.4, indicating good user acceptance, ease of use, and suitability for adolescent needs. The platform successfully provides accessible digital health content, interactive features, and online consultation support. This study concludes that SmartHealth is feasible, usable, and contextually relevant as a digital health education platform for Indonesian adolescents.**

**Keywords: SmartHealth; web-based platform; adolescent health education; usability testing; waterfall model.**

## I. INTRODUCTION

Approximately 1.3 billion adolescents (16% of the global population) are aged 10–19 years [1]. Although adolescent mortality has declined over the past two decades, the reduction has not occurred evenly across regions and population groups [2]. In the last two years, lifestyle patterns and nutritional status among Indonesian adolescents have contributed to increasing mental health problems, reproductive health issues, and drug misuse. About one in three adolescents (15.5 million individuals) experienced mental health problems in the past 12 months, and 5.5% were diagnosed with mental disorders [3], with suicide being one of the top five causes of death associated with mental disorders [4]. Furthermore, unbalanced adolescent nutrition, including both malnutrition and obesity, affects reproductive health, particularly menstrual cycles among female adolescents, and poses long-term reproductive risks [5]. Additionally, social and environmental pressures such as academic stress and low family support heighten the likelihood of drug misuse; in 2023, drug misuse prevalence reached 1.73% among individuals aged 15–64 years, equivalent to approximately 3.33 million people [6].

Although traditional school-based health education is considered the primary means of delivering health information to adolescents, this approach faces numerous constraints that limit its effectiveness. Conventional health education is often characterized by overly theoretical and minimally applicable content [7], unengaging delivery that fails to sustain adolescent participation [7-9], and insufficient support from families and communities that should reinforce health behaviors beyond the school environment [10]. Studies consistently show that teacher-centered and low-interactivity instructional approaches lead to poor information retention and an inability to achieve meaningful health behavior change among adolescents [11]. Furthermore, school health curricula in many countries are not updated regularly, making them less responsive to contemporary adolescent health issues such as mental health, digital social pressure, and addictive behaviors [12]. Limited teacher competence in digital health literacy further weakens instructional effectiveness, as many educators lack the pedagogical capacity to adapt teaching methods to the needs and characteristics of digital-native students [13]. The low involvement of parents and communities also restricts the continuity of health messages outside the classroom, which is essential for long-term behavior change[14]. Altogether, these limitations indicate that conventional health education methods are insufficient to address the complex health needs of today's adolescents, underscoring the need for more interactive, adaptive, and technology-based approaches.

Digital interventions delivered through web-based platforms and mobile applications have emerged as relevant and effective solutions for adolescent health education. Numerous studies demonstrate that digital interventions can significantly improve adolescent health literacy; for example, web-based mental health education programs have been shown to enhance adolescents' knowledge and understanding of mental health [15-17]. Moreover, mobile or web-based applications for reproductive and nutritional health education have proven effective in improving adolescents' knowledge, attitudes, and healthy behaviors compared to conventional methods [18-20]. With flexible access (anytime and anywhere), interactive features, and the ability to be tailored to local cultural and contextual needs, digital platforms offer more engaging and sustainable delivery of health information [18].

Recent studies consistently show that digital adolescent-health interventions delivered through web or mobile applications are effective in improving health literacy, mental well-being, and healthy behaviors among adolescents. For example, a recent systematic review reported that digital lifestyle interventions targeting nutrition, physical activity, and sleep successfully reduced anxiety levels and disordered eating symptoms in adolescents compared to no intervention [21]. In the area of mental health, a meta-analysis of digital positive psychology interventions for children and adolescents demonstrated improvements in emotional well-being and reductions in depressive and anxiety symptoms [22]. Regarding reproductive health, a systematic review of adolescent reproductive-health education apps (2020–2025) found that such applications consistently enhanced adolescents' knowledge, attitudes, and, in some cases, related behaviors, outperforming conventional educational methods [23].

Given the demonstrated effectiveness of digital interventions worldwide in enhancing adolescent health literacy, mental well-being, and healthy behaviors, it is increasingly urgent for Indonesia to develop digital platforms tailored to the local context. Digital health literacy among adolescents across many regions remains uneven, and access to reliable health information is often hindered by misinformation or hoaxes [24, 25]. Many schools and communities have not yet optimized efforts to strengthen digital health literacy, despite its critical role in enabling adolescents to discern accurate information and apply it effectively in their daily lives [26].

As digital interventions have been proven effective in improving adolescent health literacy and mental well-being globally, a strong theoretical foundation is required to guide the design and evaluation of such platforms in the Indonesian context; this is where TAM and HBM provide relevant frameworks. The Technology Acceptance Model (TAM) explains how adolescents' perceptions of ease of use and perceived usefulness shape their intention to use and actual adoption of digital health platforms [27]. Meanwhile, the Health Belief Model (HBM) offers a basis for examining perceived susceptibility, perceived severity, perceived benefits, perceived barriers, and self-efficacy factors that influence adolescents' willingness to engage with digital health information [28]. Additionally, this study integrates the Theory of Planned Behavior (TPB), which posits that behavior is influenced by attitude, subjective norms, and perceived behavioral control. In the context of adolescent health, TPB clarifies how attitudes toward using digital health media, social pressures from peers or family, and perceived control over technological competence shape intentions and ultimately affect actual health behaviors. Integrating TAM, HBM, and TPB enables a comprehensive analysis that addresses not only technology acceptance but also the psychological and social determinants of adolescent health behavior.

This framework is further strengthened by the Digital Health Literacy (DHL) Model, which emphasizes individuals' ability to access, understand, evaluate, and critically apply digital health information [29]. Among adolescents, digital health literacy is particularly crucial because, despite being active technology users, many still struggle to assess the credibility of information amid the widespread circulation of digital misinformation. The DHL Model highlights that the effectiveness of digital health interventions depends on adolescents' capacity to navigate applications, comprehend educational content, and utilize such information for informed health decision-making. Thus, integrating TAM, HBM, TPB, and the DHL Model provides a comprehensive theoretical foundation for assessing the acceptance, understanding, and effectiveness of digital health interventions for adolescents, while offering a robust basis for developing educational platforms that enhance knowledge, foster positive intentions, and support sustainable health behavior change.

Developing an effective digital health platform requires an iterative, user-centered Research and Development (R&D) approach; within the evaluation phase, usability testing becomes essential to ensure that the interface and functionalities align with the preferences and needs of the target demographic. Benchmarking meta-analyses indicate that the System Usability Scale (SUS) is an appropriate instrument for assessing the usability of Digital Health Apps (DHAs)

and serves as a standardized benchmark (benchmark mean ≈ 68), thereby facilitating cross-application comparisons and evidence-based design iterations [30].

SUS is widely used in evaluations of health applications because it is concise, reliable, and easy to administer in both pilot and follow-up phases. A usability literature review on health applications highlights the frequent use of SUS and recommends combining it with qualitative methods (such as think-aloud protocols and interviews) to explain *why* certain scores emerge (Septiani et al., 2024). Moreover, studies evaluating adolescent health applications specifically also commonly apply SUS (or modified versions of it) alongside user-experience measures to ensure that design, gamification elements, and content align with adolescent preferences an approach shown to help identify design issues that may not be visible through quantitative data alone [31]. Finally, recent psychometric evaluations further confirm that SUS demonstrates strong validity and reliability when applied to mobile health applications, providing an empirical foundation for its inclusion as part of the usability evaluation package in the SmartHealth R&D process [32].

Although numerous studies indicate that eHealth and mHealth interventions can enhance health literacy, physical activity, and mental well-being among adolescents including improvements in physical activity, fitness, and reductions in sedentary behavior [33] recent literature suggests that most of these interventions remain at the feasibility or basic usability-testing stage. Evidence on long-term effectiveness, broader acceptance among adolescents in middle-income countries, and adaptability to local cultural contexts remains limited [34]. This gap presents both scientific and practical opportunities to develop adolescent health-education platforms that are contextually appropriate considering culture, digital literacy levels, and internet accessibility and grounded in robust behavioral and technology-acceptance frameworks.

On the other hand, although international evidence demonstrates the potential of digital interventions to improve health literacy, mental health, and healthy behaviors among adolescents, most existing tools remain limited in scope or focus. For instance, a co-designed digital literacy app for adolescents mis-Adventures was shown to significantly improve users' ability to appraise online health information and increase self-efficacy in discerning credible health content [35]. Meanwhile, systematic reviews of digital lifestyle or mental-health interventions for youth reveal that many target only a single domain (e.g., physical activity, nutrition, or emotional well-being), rather than delivering a comprehensive, integrative health-education package [36]. What distinguishes SmartHealth is its holistic scope encompassing physical health, nutrition, reproductive health, mental health as well as its integrated theoretical framework (Technology Acceptance Model, Health Belief Model, Theory of Planned Behavior, and the Digital Health Literacy Model), along with an adaptive design and strong contextual relevance for Indonesian adolescents. Therefore, SmartHealth offers an original contribution by filling the gap between internationally developed applications that are domain-limited or single-focus and the need for a comprehensive adolescent health-education platform in Indonesia.

Accordingly, a significant research gap exists regarding the limited availability of web-based adolescent health education platforms specifically developed for the Indonesian context using theory-driven R&D approaches and evaluated with international usability standards. This study aims to address this gap through three key contributions. Empirically, it provides new evidence on the development process and usability evaluation of the "SmartHealth" platform, as well as the levels of technology acceptance and digital health literacy among Indonesian adolescents. Theoretically, it introduces a comprehensive integration of the TAM, HBM, TPB, and DHL Model as a more holistic evaluation framework compared to prior approaches. Practically and in terms of policy, this study offers a health education platform model that can be adopted by schools, healthcare providers, and government agencies, while also presenting SUS-based usability findings that serve as a reference for designing more inclusive, effective, and culturally relevant adolescent e-health interventions.

## II. METHOD

This study employs a Research and Development (R&D) approach by adopting a simplified Borg and Gall model consisting of four main stages: (1) need assessment, (2) product design, (3) product development and expert validation, and (4) limited user testing. This model was selected because it is widely applied in the development of instructional media and educational products that require strong theoretical validity and contextual relevance. To ensure a systematic software engineering process, the study also integrates the Waterfall Model, which includes requirement analysis, system design, implementation, testing, and deployment. The integration of Borg and Gall with the Waterfall Model produces a comprehensive methodological framework in which Borg and Gall ensure that the product is developed based on educational needs and

behavioral theories, while the Waterfall Model provides a structured, measurable, and rigorously tested system development process. As a result, the adolescent health education platform developed in this study demonstrates strong validity, reliability, and practical feasibility. To clarify the integration of the simplified Borg and Gall model and the Waterfall Model in this study, the complete research flow is illustrated in Fig. 1.

The research procedure (Fig. 1) began with a needs assessment through student surveys and interviews with teachers and 20 students to identify priority adolescent health topics. The findings were analyzed during the requirement analysis stage to define key system features, map educational content, and identify user characteristics. The product design phase produced application flowcharts, wireframes, and module structures, which were refined through system design involving system architecture, database schemes, and UI/UX specifications.

The development and implementation stage resulted in the initial "SmartHealth" prototype. Expert validation was then conducted involving two public health experts, one educational technology specialist, and one UI/UX expert to assess content suitability, pedagogical alignment, and interface usability. Revisions were made based on expert feedback before proceeding to usability testing and limited field trials to evaluate usability performance, user errors, task completion, and final product refinement.

A total of 60 high school students were recruited through purposive sampling based on school recommendations. Inclusion criteria were: (1) age between 15 and 18 years, (2) access to a smartphone or laptop, (3) ability to operate web-based applications, and (4) willingness to participate in the study. Exclusion criteria included cognitive impairments and the absence of parental or guardian consent. The participants consisted of 31 female and 29 male students.

Ethical approval for this study was granted by the Research Ethics Committee of Bale Bandung University, Indonesia. Prior to data collection, formal permission was obtained from the school administration. The research objectives and procedures were explained to participating students, who were then asked to convey the information to their parents or legal guardians. Written informed consent forms were distributed to parents or guardians through the students and collected after being signed. Only students who returned completed informed consent forms were included in the study. All procedures complied with ethical principles for research involving human subjects, including voluntary participation, confidentiality, anonymity, and the right to withdraw at any time without consequences.

Usability was assessed using the standard 10-item System Usability Scale (SUS). Each item was rated on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree). SUS scoring followed the standard procedure: for odd-numbered items (1, 3, 5, 7, 9), the contribution score was calculated as (response − 1), while for even-numbered items (2, 4, 6, 8, 10), the contribution score was calculated as (5 − response). The SUS score for each participant was obtained by summing all contribution scores and multiplying the total by 2.5, yielding a score range of 0–100. Usability testing was conducted during a 20-minute interaction session in which participants explored the main features of the SmartHealth platform.

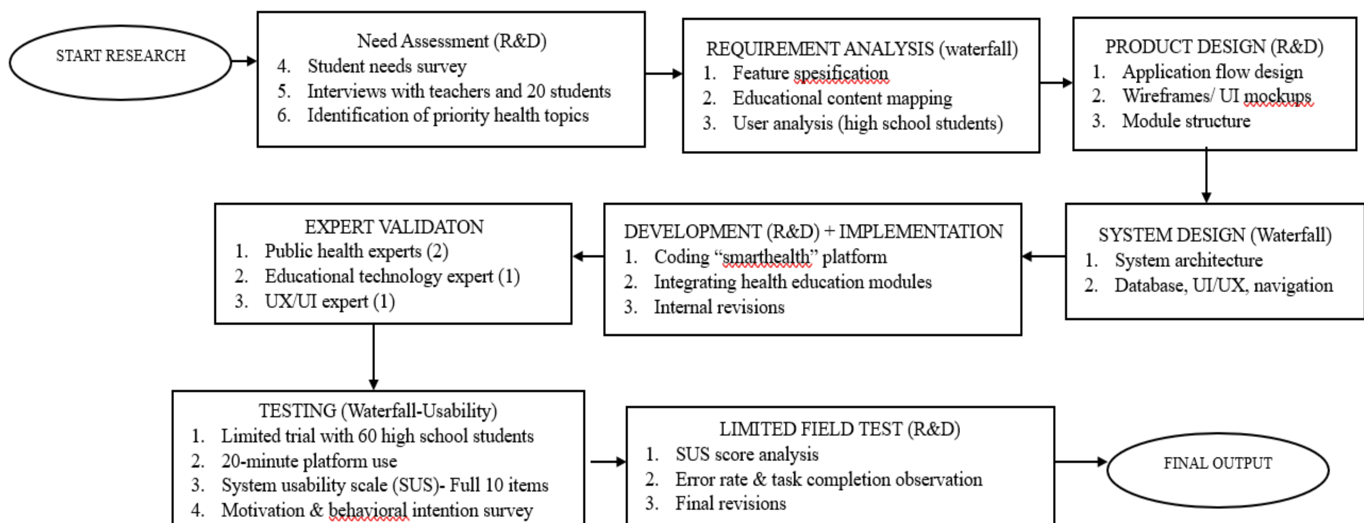


**Fig. 1 Research flow of SmartHealth development**

Data analysis involved both descriptive and inferential statistical techniques. Descriptive statistics included the SUS mean score, standard deviation, score distribution, error rates, and task completion time. Inferential analyses included Pearson correlation tests to examine relationships between usability, motivation, and behavioral intention; independent samples t-tests to analyze gender differences; and simple regression analysis to assess the influence of usability on intention to use. These analyses were conducted in alignment with the Technology Acceptance Model (TAM) and the Theory of Planned Behavior (TPB).

The SmartHealth platform implements strict data privacy and security measures to protect adolescent users. No personally identifiable information (PII) is collected, and all usage data are stored in anonymized form. The system uses secure HTTPS connections, server-side data encryption, and role-based access control restricted to authorized system administrators. Given the sensitivity of health-related content, all educational materials undergo expert review prior to deployment, and no user-generated content is permitted. These measures ensure compliance with ethical standards for digital health applications targeting minors.

# III. RESULT AND DISCUSSION

## A. Needs Analysis

The needs analysis revealed that most students still face various obstacles in accessing relevant health education. A total of 82% of students reported never having received digital-based health education, while 76% indicated that school health materials remain theoretical and unengaging. Moreover, 71% stated that they struggle to distinguish valid health information from hoaxes, particularly when sourced from social media. These findings were supported by teacher interviews, which highlighted limited instructional time and the lack of interactive media as major barriers to delivering effective health education. Students' preference for concise, interactive, visual, and user-friendly digital media served as the basis for developing SmartHealth, which is designed to directly address students' needs for accurate, engaging, and contextually relevant health information.

## B. System Requirements

The System Requirements was conducted systematically to identify both functional and non-functional needs prior to system design and development. This stage began with interviews and observations involving the Vice Principal for Student Affairs and IT staff at SMAN 2 Majalaya, complemented by document analysis such as school activity schedules and previous health counseling reports. The findings indicated that the school lacked a digital information system specifically designed to support student health education; health materials were still delivered manually through face-to-face counseling by external parties such as the local health center, making the process non-inclusive, dependent on speaker availability, and unable to provide reusable learning materials. Furthermore, no interactive learning media were available to allow students to independently study key topics such as healthy lifestyles, mental health, reproductive health, nutrition, and drug abuse prevention.

Based on these findings, several functional requirements were identified, including user management (admin and students), educational content management for five health categories, health information pages, interactive features (likes and comments), and Zoom Meeting integration for online counseling. Non-functional requirements included responsive design for access via smartphones and laptops, secure login and authentication, as well as high system availability and reliability. These requirement specifications formed the foundation for designing the system architecture and core features of SmartHealth.

## C. System Design

To ensure the protection of users' personal information, the SmartHealth system incorporates multiple layers of data security within its system architecture. User accounts are secured through role-based authentication, requiring unique credentials for students, counselors, and administrators. All sensitive data particularly health-related consultation records are encrypted both in transit and at rest, and personal identifiers are anonymized when used for analytical or reporting purposes. The platform also implements a moderation workflow in which health consultations submitted by students are filtered and reviewed by certified school counselors before feedback is delivered, ensuring that the information provided is accurate and aligns with school health guidelines. The system is hosted on a secure cloud server managed by the institution's IT department, which complies with national ICT security regulations and internal school data governance policies. Regular backups, access logging, and restricted administrative privileges further strengthen data protection and reduce the risk of unauthorized access or data breaches.

System Architecture Design: The platform uses a client–Server architecture in which the client provides an interactive web interface, while the server manages

application logic, data processing, and security. Developed with the Laravel Framework and its MVC structure, the system ensures scalability, modularity, and maintainability. A MySQL relational database is employed to securely store user data, educational content, discussion activities, and consultation records. The architecture supports multi-user access, responsive performance, and integration of multimedia learning modules to ensure optimal functionality and usability.

*1) Use Case Modeling:* A Use Case Diagram is applied to illustrate system interactions involving two main actors: Admin and Users. The admin manages health content, updates modules, and schedules online consultations via Zoom. Users (students) access educational materials, participate in discussions, submit comments, and join consultation sessions. This model clarifies functional requirements, defines actor responsibilities, and ensures that the system design aligns with user needs for effective implementation of the SmartHealth platform. To further specify the functional requirements and user interactions, the Use Case and Activity Diagrams are illustrated in Fig. 2.

*2) Activity Diagram*: flow from content upload to student interaction. The User Education Material Activity Diagram illustrates the sequence of activities performed by users when accessing the educational material feature in the system. The process begins when the user selects the “Education Material” menu, after which the system displays a page containing the list of available materials. The user can then perform several main actions, including downloading material files, liking materials, leaving comments, or selecting a category of educational materials. If the user chooses to download a file, the system processes the request and delivers the requested file. When the user likes a material, the system records this action as a form of appreciation. In addition, users may provide comments on the displayed material, and the system stores these comments accordingly. To facilitate material search, users can select specific categories, and the system will display materials that match the selected category. The process ends when the user completes their interaction with the educational material feature.

The database design is structured using a Class Diagram to clearly illustrate the relationships between entities and to facilitate the translation into a relational database schema. The main entities defined in the system include Users, Health Materials, Health Articles, Zoom Schedules, and Comments. The Users entity stores essential information such as user profiles, login credentials, and roles (Admin or User). The Health Materials and Health Articles entities contain structured educational resources that can be accessed by users. The Zoom Schedule**s** entity manages consultation session schedules, linking both Admin and Users for online interactions. The Comments entity enables users to provide feedback or engage in discussion related to health content.

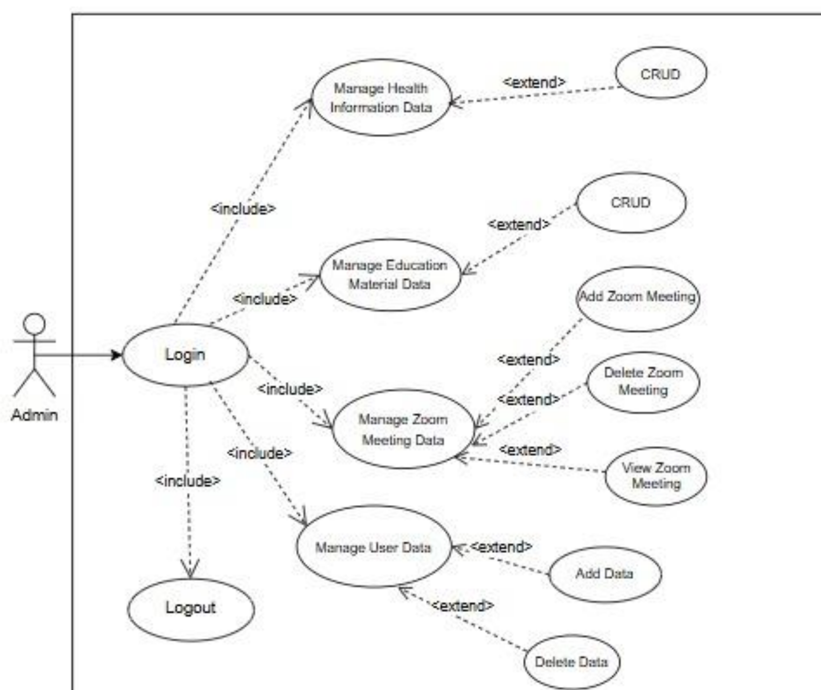


**Fig. 2 Use case and activity diagrams of the SmartHealth Platform**

UI/UX Design: The user interface and experience design were developed using Balsamiq Mockup to produce wireframes that outline the layout and navigation flow. The wireframes cover key system pages, including the User Dashboard (quick access to materials and Zoom schedules), Health Information Page (curated articles and announcements), Educational Material Page (interactive modules and multimedia content), and Discussion Forum (user communication and knowledge sharing). This UI/UX approach prioritizes simplicity, accessibility, and user-centered interaction to ensure adolescents can navigate the platform easily and remain engaged. The wireframes also serve as a development guide, aligning visual design with functional requirements during implementation.

*3) Implementation Phase:* The implementation phase focuses on building the system based on the approved design specifications. Development is carried out using the Laravel Framework for backend processes, MySQL for database management, and HTML/CSS/JavaScript for the frontend. Each module is implemented following the MVC structure to maintain modularity and scalability. Key activities include developing the User Dashboard, Health Information, Educational Materials, and Discussion Forum modules; implementing role-based authentication; integrating the Zoom API for online consultation scheduling; ensuring responsive interface performance; and conducting unit and integration testing to verify system reliability. To illustrate the system development results, the SmartHealth application interface design is presented in Fig. 3, while the implemented web-based interface as displayed in the browser is shown in Fig. 4.

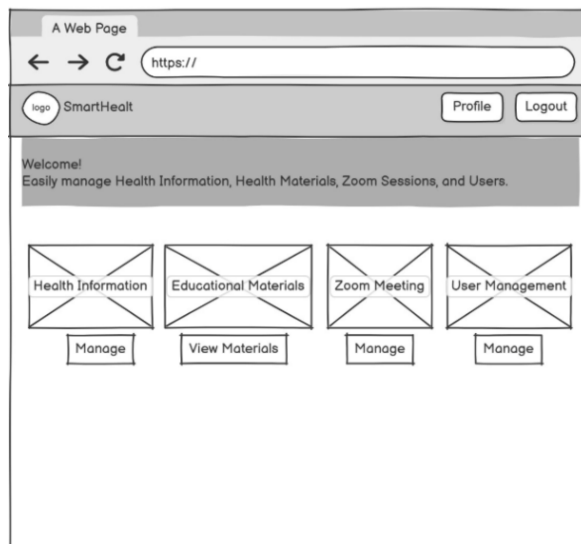


**Fig. 3 SmartHealth application interface design prototype**

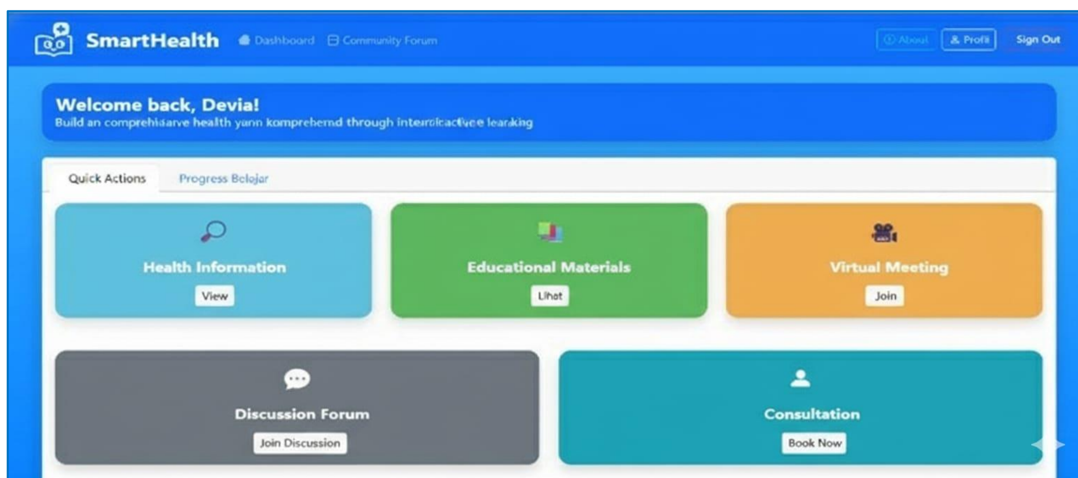


**Fig. 4 SmartHealth web-based interface implementation**

*D. System Testing and Evaluation*

The testing phase is conducted to ensure that the system operates according to the defined specifications and provides a user-friendly experience. Various types of testing are applied to validate both functionality and usability.

Black-Box Testing: This method focuses on testing the system's functionalities without examining the internal source code. The primary objective is to verify whether the input and output behave as expected. Key functionalities tested include:

*1) Login/Authentication:* verifying that users can log in with valid credentials and are restricted with invalid data.

Content Management (Upload/Update): ensuring that Admins can upload, edit, and manage educational materials and health articles successfully.

*2) Comments and Discussion Forum:* confirming that users can post, view, and interact with comments smoothly.

Zoom Integration: testing the process of joining scheduled Zoom sessions through the platform to ensure seamless redirection and participate.

*3) Usability Testing (SUS Method):* Usability testing was conducted using the System Usability Scale (SUS) as described in the Method section. Respondents were asked to rate their agreement with each statement on a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree).

As shown in Table I, a total of 60 students participated in the survey, comprising 18 males (30.00%) and 42 females (70.00%). Regarding age distribution, most respondents were 16 years old (n = 36, 60.00%), followed by 17 years (n = 14, 23.33%), 15 years (n = 8, 13.33%), and 18 years (n = 2, 3.33%). Overall, the participants were predominantly female and mainly aged 16 years.

**Usability and user satisfaction**

The high usability ratings given by students can be explained by several mutually reinforcing design and content factors. The strong agreement regarding ease of use (88.4%), feature integration (91.7%), simple learnability (86.7%), intuitive navigation (95%), and an appealing interface (88.3%) indicates that SmartHealth successfully fulfills key constructs of the Technology Acceptance Model, particularly *perceived ease of use* and *perceived usefulness*. These outcomes were supported by a clean interface structure, clear menu hierarchy, and seamless integration of modules such as materials, quizzes, forums, and consultation services. Furthermore, the clarity and relevance of the educational content reflected in students' reports that the materials were easy to understand (88.4%) and enhanced their comprehension of health topics (93.3%) strengthened users' *self-efficacy* and perceived benefits as outlined in the Health Belief Model. Interactive elements such as the discussion forum and online consultation also increased social engagement and comfort in seeking help (78.4%), reinforcing the social influence and behavioral intention components of the Theory of Planned Behavior. Additionally, the platform's structured information flow and support features enhanced students' digital health literacy, enabling them to assess and apply health information more effectively. Taken together, these elements not only explain the high SUS score (mean = 78.4, SD = 8.6) but also demonstrate that the integration of usability, relevant content, and interactive learning components significantly contributed to students' positive engagement with SmartHealth.

**Content and learning aspect**

The analysis of the content and learning aspect shows that the SmartHealth application provides valuable educational support for students. A total of 88.4% of respondents agreed that the content is easy to understand, and 88.3% found the forum or consultation feature beneficial for the learning process. Furthermore, 93.3% stated that the materials helped them better understand health topics, while 91.7% reported an increase in their knowledge after using the application. In addition, 88.3% agreed that the exercises or quizzes supported their understanding. These findings indicate that the content of SmartHealth is relevant, easy to comprehend, and effectively enhances students' knowledge.

Although a large proportion of respondents stated that SmartHealth helped them understand health topics better, this perception reflects *self-reported learning experience* rather than objectively measured knowledge improvement. Since no pre–post knowledge assessment was conducted in this study, the findings should be interpreted as indicators of perceived learning support rather than verified cognitive gains. Therefore, the results emphasize students' positive impressions of content clarity, relevance, and usefulness, without claiming measurable increases in actual knowledge.

Motivation and intention to use.

TABLE I

DISTRIBUTION OF PARTICIPANTS BY GENDER AND AGE

| Category | n | % |
|---|---|---|
| Gender | | |
| Male | 18 | 30.00 |
| Female | 42 | 70.00 |
| Age | | |
| 15 years | 8 | 13.33 |
| 16 years | 36 | 60.00 |
| 17 years | 14 | 23.33 |
| 18 years | 2 | 3.33 |
| Total | 60 | 100.00 |

The analysis of motivation and intention to use demonstrates that the SmartHealth application not only supports the learning process but also encourages students to remain engaged. A total of 73.3% of respondents felt motivated to complete the modules, 76.7% frequently used interactive features, and 78.4% felt comfortable asking questions in the forum. Moreover, 86.7% expressed their intention to continue using the application in the future. These results highlight that SmartHealth is effective in fostering both learning motivation and sustainable user engagement.

To complement the quantitative findings, qualitative feedback was collected from students during the usability testing session. Overall, the responses reinforced the numerical results, especially regarding usability, clarity of content, and learning support. Several students highlighted the intuitive interface, noting that *“the menu is easy to navigate even for first-time users”* and that *“the layout helps me find materials quickly without getting confused.”* Others emphasized the usefulness and relevance of the educational content, with comments such as *“the explanations are simple and make difficult health topics easier to understand”* and *“the materials and quizzes really help me remember what I learned.”* Interactive features also received positive remarks; for example, one student stated, *“I feel more comfortable asking questions in the forum than in class,”* while another added, *“the consultation feature makes it easier to discuss sensitive health topics privately.”* These qualitative insights provide concrete examples that support the statistical results and demonstrate that SmartHealth’s usability, content clarity, and interactive functions contribute meaningfully to user engagement.

**Most helpful features**

The analysis of the most helpful features shows that 25% of respondents found the health materials to be the most beneficial, 18.3% highlighted the consultation feature, and 31.7% considered all features equally useful. This indicates that the core features of the application are widely valuable, with additional strengths particularly in the educational content and consultation services.

**Difficulties Encountered and Suggestions for Improvement**

A total of 83.3% of respondents reported experiencing no difficulties, indicating that the application is relatively stable and easy to use. The majority of respondents suggested adding more features (38.3%), while 16.7% recommended enhancing the visual design, and 28.3% stated that the application was already good as it is. These suggestions highlight a focus on further feature development and design improvements to enhance the overall user experience.

The findings of this study indicate that SmartHealth was positively received by students; however, the broader significance of these results extends beyond numerical usability scores. The high level of user approval can be interpreted through established technology adoption theories. From the perspective of the Technology Acceptance Model (TAM), students perceived SmartHealth as both useful and easy to use, which likely contributed to their engagement with the platform. This finding is consistent with previous studies indicating that digital learning tools with intuitive navigation and accessible content enhance users’ intention to continue use. Furthermore, sustained use patterns and active exploration of multiple modules suggest that SmartHealth supported students’ psychological needs for autonomy, competence, and relatedness, in line with Self-Determination Theory (SDT). By enabling learners to access materials at their own pace, receive clear feedback, and engage with health topics relevant to their daily lives, the platform appears to foster intrinsic motivation rather than passive information consumption.

Beyond theoretical integration, the results also highlight contextual considerations specific to Indonesian school environments. The inclusion of sensitive topics such as reproductive health and mental

wellbeing requires culturally responsive design and delivery. The positive reception of SmartHealth suggests that students valued having a safe, private, and non-judgmental digital space to explore these issues, reflecting an increasing readiness among Indonesian adolescents to engage with evidence-based health information. Nevertheless, this underscores the importance of ensuring alignment with local cultural norms, parental expectations, and school policies, particularly in contexts where discussions related to sexual and mental health remain limited.

### Implications For Practice and Policy

From a practical perspective, digital platforms such as SmartHealth can serve as scalable complements to traditional school-based health education programs. The platform may support teachers and school counselors by providing structured, standardized, and evidence-based educational materials, while enabling students to access reliable health information beyond classroom hours. Its demonstrated usability suggests that similar web-based interventions can be implemented in secondary school settings with minimal technological barriers.

From a policy perspective, the findings support the integration of digital health education platforms into formal school health initiatives to strengthen long-term adolescent health literacy. Policymakers may consider adopting theory-driven digital tools such as SmartHealth, provided that implementation is accompanied by appropriate teacher training, content standardization, ethical oversight, and continuous monitoring to ensure cultural relevance, data protection, and responsible use among minors.

## IV. CONCLUSION

This study concludes that the SmartHealth web-based interactive platform has successfully enhanced adolescent health literacy by integrating learning on healthy lifestyles, reproductive health, mental health, and drug prevention into a single, accessible system. Usability testing indicated that the majority of users found the application easy to use, engaging, and effective in improving knowledge and motivation to learn. These findings imply that digital, interactive platforms like SmartHealth can play a significant role in supporting adolescent health education, facilitating independent learning, and promoting informed health decision-making. However, this pilot study has several limitations. The sample size was relatively small, limited to 60 students from a single school, and the study did not include direct measurement of actual behavioral changes or long-term learning outcomes. These factors restrict the generalizability of the results and the ability to confirm sustained behavior improvements. Future research should aim to address these limitations by testing the SmartHealth platform in multiple schools across diverse regions, integrating gamification and other engagement strategies to further enhance motivation, and conducting longitudinal studies to evaluate the impact on health-related behaviors and long-term learning outcomes. Additionally, expanding features based on user feedback could strengthen interactivity, engagement, and practical applicability of the platform. Overall, SmartHealth represents a promising, user-centered, and replicable model for adolescent digital health education, with potential for broader implementation and refinement.

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