

Development of the Website Application Lia's Dent Early Detection of Gingivitis to Improve Dental and Oral Health Maintenance Behavior for Pregnant Women

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Abstract: Dental and oral health problems in Indonesia are still high with a prevalence of 57.6%. Gingivitis often occurs in pregnant women due to hormonal changes, but only a small percentage get treatment. The Lia's Dent Website application was developed as a digital educational medium to improve dental and oral health maintenance behaviors and early detection of gingivitis. **Objective:** Develop appropriate and effective media to improve dental and oral health maintenance behaviors and early detection of gingivitis. This study used a R&D approach. Data were collected through interviews, questionnaires, and observations. Application feasibility was assessed using Aiken's V and the ICC. Effectiveness was evaluated through a quasi-experimental pretest–posttest control group design involving 40 pregnant women. Data were analyzed using the Wilcoxon and Mann–Whitney tests. The Lia's Dent Website application is applied for 14 days. The validation results showed that the application was feasible to use (Aiken's $V=0.963$; $p=0.003$). The use of the app significantly improved knowledge, attitudes, and skill to maintain dental and oral health ($p<0.001$), as well as improved the ability to detect gingivitis early ($p=0.001$). The results of the comparative test also showed that the Lia's Dent Website Application was more effective than the counseling media in demonstration ($p<0.001$). The Lia's Dent Website application is feasible and effective to be implemented as an effort to improve dental and oral health maintenance behavior and early detection of gingivitis in pregnant women compared to conventional media.

Keywords: Lia's Dent, Gingivitis, Pregnant Women, Dental and Oral Health, Early Detection.

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I. INTRODUCTION

Oral health is an essential component of overall health. The Fédération Dentaire Internationale (FDI) defines oral health as a condition that enables individuals to speak, smile, chew, swallow, and express emotions without pain, discomfort, or disease affecting the craniofacial complex.[1] Maintaining good oral hygiene plays a crucial role in preventing dental caries and periodontal diseases, while also supporting overall health.[2]

Oral health is particularly important during pregnancy, as it contributes significantly to maternal and overall health. During pregnancy, increased levels of estrogen and progesterone hormones make pregnant women more susceptible to gingival disorders, particularly pregnancy gingivitis. Pregnancy gingivitis is characterized by swollen, erythematous, and easily bleeding gingiva. If left untreated,

gingivitis may progress to periodontitis, leading to the destruction of tooth-supporting tissues and increasing the risk of adverse pregnancy outcomes, including preterm birth and low birth weight infants.[3]

Oral hygiene habits are an important factor influencing the development of gingivitis. Habits such as infrequent toothbrushing, failure to clean between teeth, and frequent consumption of sugary foods can increase plaque buildup.[4] In pregnant women, oral health care behaviors often decline due to nausea, fatigue, and the belief that dental care may harm the fetus. These conditions lead pregnant women to brush their teeth less regularly and visit the dentist less frequently, thereby increasing the risk of gingivitis during pregnancy.[5] Research findings indicate that pregnant women with poor oral hygiene habits have a higher risk of developing gingivitis compared to those who maintain regular oral hygiene.[6] Additionally, hormonal changes during pregnancy can

intensify the inflammatory response of the gums to plaque bacteria, thereby worsening the condition if no preventive measures are taken.[7]

In addition to individual behavior, limited access to health information and education has led many pregnant women to not yet understand the importance of maintaining oral health during pregnancy. As a result, some pregnant women only seek care when symptoms such as bleeding gums or toothaches appear.[8]

Initial Efforts The government has integrated oral health services into antenatal care through pocket guides and health education sessions. However, these methods remain conventional, are unable to monitor behavior on an ongoing basis, and do little to encourage the active involvement of pregnant women.[9] The Pregnant Dental Health Information System (PREDHIS) has been developed as a tool for detecting risk factors, but its use is still limited to feasibility studies and has not yet evaluated changes in behavior or the prevalence of gingivitis.[10]

Observations at the Plajan Village Integrated Services Pos, within the service area of the Pakis Aji Community Health Center, show that most pregnant women have limited knowledge of oral health. The majority have never received health education from healthcare workers and still believe that dental checkups during pregnancy can harm the fetus. Initial examinations also revealed signs of gingivitis, such as red, swollen, and easily bleeding gums.

Given these conditions, there is a need for a technology-based innovation capable of integrating education, behavioral monitoring, and early detection of gingivitis. This study developed the web-based application “Lia’s Dent,” which integrates these three components into a single digital platform. Unlike previous studies, this application not only focuses on detecting risk factors but also evaluates its effectiveness in improving oral health maintenance behaviors and its ability to detect gingivitis early in pregnant women through a Research and Development (R&D) approach with a control group.

II. RESEARCH METHODS AND SAMPLE

This study employed a Research and Development (R&D) methodology adapted from the Borg and Gall development model, encompassing the stages of information gathering, product design, expert validation, product testing, revision, and the final product.¹⁶ The information-gathering stage was conducted through literature reviews, observations, and interviews to identify the needs of pregnant women regarding oral health education materials. Based on these findings, the web-based application “Lia’s Dent” was developed, integrating oral health education, monitoring of oral health maintenance behaviors, and early detection of gingivitis.¹⁶

The application’s feasibility was assessed by subject matter experts, media experts, and information technology experts using a validation checklist. Content validity was analyzed using Aiken’s V, while inter-validator agreement

was analyzed using the Intraclass Correlation Coefficient (ICC). The effectiveness test employed a quasi-experimental pretest–posttest design with a control group.[11] The study was conducted at the Tlogosari Kulon Community Health Center, Semarang City, from February to March 2026.

The study population consisted of all pregnant women registered in the service area of the Tlogosari Kulon Community Health Center (UPTD Puskesmas). The study sample consisted of 40 pregnant women selected using purposive sampling according to inclusion and exclusion criteria, then divided into two groups: the intervention group (n = 20), which used the Lia’s Dent website application, and the control group (n = 20), which received education through demonstration.

The research instruments included a questionnaire on oral health maintenance behavior, a questionnaire on early detection of gingivitis, an observation sheet, and an expert validation sheet. All instruments underwent validity and reliability testing prior to use.

In the intervention group, participants used the Lia’s Dent app for 14 days, which included educational materials, pretests and posttests, a daily activity feature to monitor oral health maintenance behaviors, and an early gingivitis detection feature. The control group received education through demonstrations in accordance with the community health center’s antenatal care procedures. Measurements were taken before the intervention (pretest) and after the intervention (posttest).

Data analysis was conducted using descriptive and inferential methods. The Shapiro–Wilk test was used to assess normality. Differences in scores before and after the intervention within each group were analyzed using the Wilcoxon test, while differences in effectiveness between the intervention and control groups were analyzed using the Mann–Whitney test.[12]

III. RESULTS

A. Lia's Dent Information Collection Result

Data was collected through interviews with several informants in the study area, including the Head of the Community Health Center (R1), a health worker (R2), and a pregnant woman (R3). The findings indicated that oral health programs for pregnant women have been implemented through integrated antenatal care and prenatal classes. However, education still relies on conventional media such as face-to-face counseling, flip charts, and dental models, and faces challenges including limited resources, suboptimal monitoring and evaluation, and a lack of engagement among some pregnant women. Interview results indicate that pregnant women need educational materials that are engaging, easy to understand, and accessible independently. The use of a web application received a positive response because it was considered capable of increasing knowledge, monitoring oral health behaviors, and supporting the early detection of gingivitis. Therefore, the development of the Lia’s Dent Web Application is deemed appropriate to meet the needs of

pregnant women as a medium for education and the early detection of gingivitis.

B. Model Design and Development

Based on the data collected, it was found that pregnant women are interested in and more enthusiastic about an IT-based educational model that has been tailored to their characteristics and needs, as well as to the existing issues they face. Therefore, the researcher developed the “Lia’s Dent” web application, which aims to improve oral health maintenance behaviors and facilitate the early detection of gingivitis among pregnant women.

During the design phase, the system was developed using the Unified Modeling Language (UML) as the basis for designing the system flow, then implemented using the Laravel framework, the PHP programming language, and a MySQL database, resulting in a web-based application that can be accessed online. The Lia’s Dent application is designed for two types of users: pregnant women and oral health professionals (administrators). For pregnant women, the application provides features for logging in, a pre-test, educational materials on oral health during pregnancy, a post-test, monitoring of daily activities, and user profile management. Through these features, users can educate themselves independently while continuously monitoring their oral health maintenance Skills s.

Meanwhile, the administrator interface includes features for managing patient data, monitoring users’ daily activities,

managing educational materials, administering questionnaires, evaluating pre-test and post-test results, monitoring early-detection results for gingivitis, and managing user feedback. These features enable healthcare professionals to monitor, evaluate, and update educational materials in an integrated manner. The app’s workflow begins with user registration and login, followed by a pre-test to assess initial levels of knowledge, attitudes, and oral health maintenance Skills s. Users then access educational materials, track their daily activities, and complete a post-test to evaluate changes in behavior. All user data is stored in a database and can be monitored in real time by healthcare professionals via the administrator dashboard. With this design, the Lia’s Dent app functions not only as an educational tool but also as an integrated system for monitoring health behaviors and the early detection of gingivitis.

C. Expert Validation

Expert validation in this study was conducted by three experts: a dentist, a health promotion specialist, and an IT specialist. The data from the experts’ assessments were analyzed using Aiken’s V to determine the validity of each item in the instrument and the Intraclass Correlation Coefficient (ICC) to assess the consistency of the data from the Lias’s Dent app.

• Validity Test

Tabel 1 Expert Validation Website Lia’s Dent

Validator	Score (%)	Kriteron
Expert 1	91,67%	Very Acceptable
Expert 2	100%	Very Acceptable
Expert 3	100%	Very Acceptable
Average ($\bar{x}$)	96,3%	Highly Acceptable
Aiken’s V	0,963*	Hight
p-value	0,003**	Significant
ICC	0,857**	Adequate

Table 1 shows that the feasibility scores given by the experts had an average of 96.32%, meaning that the Lias’s Dent app is highly feasible; and based on an Aiken’s V value of 0.963, the Lias’s Dent app—as an effort to improve oral health maintenance behaviors and the early detection of gingivitis—has high validity.

Following the validity assessment, a reliability test was conducted to evaluate the consistency of the data from the Lias’s Dent App assessment using the Intraclass Correlation Coefficient (ICC). The result was 0.857, indicating that the reliability of the Lias’s Dent App is adequate; the p-value of 0.003 ($p < 0.05$) indicates statistical significance. Based on the

validity and reliability tests, as well as the feasibility assessment by experts, the Lias’s Dent app is deemed suitable for use as an oral health education tool for pregnant women to improve oral health maintenance behaviors and facilitate the early detection of gingivitis.

D. Product Result

This pilot study was conducted at the Tlogosari Kulon Community Health Center (UPTD Puskesmas), with pregnant women serving as the intervention and control groups. The intervention group received the Lia’s Dent app for 14 days, while the control group received education through demonstrations.

Table 2 Frequency Distribution Characteristics of Respondents

Characteristic	Group			
	Intervention		Control	
	F	%	F	%
Age				
20 – 30 years	13	65.0	14	70.0
31– 40 years	7	35.0	4	20.0

41– 50 years	0	0	2	10.0
Total	20	100	20	100
Education				
Junior Hight School	4	20.0	6	30.0
Senior Hight School	13	65.0	11	55.0
Higher Education	3	15.0	3	15.0
Total	20	100	20	100

Table 2 shows that the majority of respondents in both the intervention and control groups were in the 20–30 age range, with 13 respondents (65.0%) and 14 respondents (70.0%), respectively. Based on educational level, the majority of respondents in both groups had a high school diploma as their highest level of education: 13 respondents

(65.0%) in the intervention group and 11 respondents (55.0%) in the control group. In general, the characteristics of the respondents in both groups were relatively similar, with the majority aged 20–30 years and having a high school education, meaning that the two groups had fairly comparable demographic characteristics.

Table 3 Data on the Level of Knowledge Regarding Oral Health Care

Knowledge	Group							
	Intervention				Control			
	Pretest		Posttest		Pretest		Posttest	
	F	%	F	%	F	%	F	%
Good	0	0	20	100	0	0	10	50.0
Fair	11	55.0	0	0	10	50.0	10	50.0
Poor	9	45.0	0	0	10	50.0	0	0
Total	20	100	20	100	20	100	20	100

Table 3 shows that in the intervention group, prior to the intervention, most respondents had knowledge levels in the fair (55.0%) and poor (45.0%) categories, whereas after the intervention, all respondents (100%) were in the good category. In the control group, before the study, 50.0% of

respondents were in the fair and poor categories, and after the posttest, 50.0% were in the good category and 50.0% in the fair category. These results indicate an increase in knowledge in both groups, with a greater increase in the intervention group.

Table 4 Average Data on Knowledge of Oral Health Care

Variabel	$\bar{x}$	Statistic		
		SD	Min	Max
Intervensi				
Pretest	8.70	3.13	3	17
Posttest	18.20	1.39	12	20
Kontrol				
Pretest	7.95	2.56	5	12
Posttest	14.65	1.63	12	18

Table 4 shows that the mean knowledge score ($\bar{x}$) in the intervention group increased from 8.70 on the pretest to 18.20 on the posttest. In the control group, the mean knowledge

score increased from 7.95 on the pretest to 14.65 on the posttest. These results indicate an increase in knowledge in both groups following the intervention.

Table 5 Data on Attitudes Toward Oral Health Care

Attitudes	Group							
	Intervensi				Kontrol			
	Pretest		Posttest		Pretest		Posttest	
	F	%	F	%	F	%	F	%
Good	0	0	20	100	0	0	7	35.0
Fair	1	5.0	0	0	0	0	13	65.0
Poor	19	95.0	0	0	20	100	0	0
Total	20	100	20	100	20	100	20	100

Table 5 shows that in the intervention group, before the intervention, most respondents had an “inadequate” attitude (95.0%), whereas after the intervention, all respondents

(100%) fell into the “good” category. In the control group, before the study, all respondents (100%) fell into the “poor” category; after the posttest, 35.0% fell into the “good”

category and 65.0% into the “fair” category. These results indicate an improvement in attitudes in both groups, with a greater improvement in the intervention group.

Table 6 Average Data on Attitudes Toward Oral Health Care

Variabel	$\bar{x}$	Statistik		
		SD	Min	Max
Intervensi				
Pretest	32.30	3.79	26	40
Posttest	69.65	4.56	63	76
Kontrol				
Pretest	31.95	7.20	24	55
Posttest	55.30	5.58	49	68

Table 6 shows that the mean ($\bar{x}$) attitude toward oral health care in the intervention group increased from 32.30 on the pretest to 69.65 on the posttest. In the control group, the mean attitude score increased from 31.95 at the pretest to

55.30 at the posttest. These results indicate an improvement in attitudes in both groups following the intervention, with a greater improvement observed in the intervention group.

Table 7 Data on Oral Health Care Skills

Kelompok								
Skills	Intervensi				Kontrol			
	Pretest		Posttest		Pretest		Posttest	
	F	%	F	%	F	%	F	%
Good	0	0	20	100	0	0	1	5.0
Fair	9	45.0	0	0	8	40.0	16	80.0
Poor	11	55.0	0	0	12	60.0	3	15.0
Total	20	100	20	100	20	100	20	100

Table 7 shows that in the intervention group, prior to the intervention, most respondents fell into the “poor” (55.0%) and “fair” (45.0%) categories, whereas after the intervention, all respondents (100%) were in the “good” category. In the control group, before the study, most respondents were in the

“poor” (60.0%) and “adequate” (40.0%) categories; after the posttest, 5.0% were in the “good” category, 80.0% in the “adequate” category, and 15.0% in the “poor” category. These results indicate an improvement in behavior in both groups, with a greater improvement in the intervention group.

Table 8 Average Data on Oral Health Care Skills

Variabel	$\bar{x}$	Statistic		
		SD	Min	Max
Intervention				
Pretest	8.70	3.13	3	17
Posttest	18.20	1.39	12	20
Control				
Pretest	7.95	2.56	5	12
Posttest	14.65	1.63	12	18

Table 8 shows that the mean ($\bar{x}$) of oral health care Skills in the intervention group increased from 7.75 on the pretest to 19.50 on the posttest. In the control group, the average number of actions increased from 7.50 at the pretest to 11.20

at the posttest. These results indicate an increase in actions in both groups following the intervention, with a greater increase observed in the intervention group.

Table 9 Data on Early Detection of Gingivitis in Pregnant Women

Early Detection of Gingivitis	Group							
	Intervention				Control			
	Pretest		Posttest		Pretest		Postes	
	F	%	F	%	F	%	F	%
No signs of gingivitis	14	70.0	20	100	14	70.0	14	70.0
Signs of gingivitis	6	30.0	0	0	6	30.0	6	30.0
Total	20	100	20	100	20	100	20	100

Table 9 shows that in the intervention group, the percentage of respondents who showed no signs of gingivitis increased from 70.0% to 75.0%, while the percentage of those who showed signs of gingivitis decreased from 30.0% to 25.0%. In the control group, all respondents (100%) showed

no signs of gingivitis in both the pretest and posttest. These results indicate an improvement in gingival condition in the intervention group, whereas no change occurred in the control group.

Table 10 Average Data on Early Detection of Gingivitis in Pregnant Women

Variabel	$\bar{x}$	Statistik		
		SD	Min	Max
Intervensi				
Pretest	7.05	7.50	0	20
Posttest	0.40	0.94	0	3
Kontrol				
Pretest	6.70	6.90	0	20
Posttest	6.45	6.49	0	18

Table 10 shows that the mean ($\bar{x}$) score for early detection of gingivitis in the intervention group changed from 7.05 on the pretest to 0.40 on the posttest. In the control group, the mean early gingivitis detection score changed from

6.70 at the pretest to 6.45 at the posttest. These results indicate a decrease in gingivitis symptom scores, with a greater reduction observed in the intervention group.

Table 11 Normality Test

Variabel	Group	p-value	Normality
Knowledge	Pre-test intervention	0,008*	Not normal
	Post-test intervention	0,000*	Not normal
	Pre-test control	0,016*	Not normal
	Post-test control	0,294*	Normal
Attitude	Pre-test interventio	0,008*	Not normal
	Post-test intervention	0,000*	Not normal
	Pre-test control	0,001*	Not normal
	Post-test control	0,247*	Normal
Skills	Pre-test intervention	0,409*	Normal
	Post-test intervention	0,034*	Not normal
	Pre-test control	0,000*	Not normal
	Post-test control	0,016*	Not normal
Early Detection of Gingivitis			
	Pre-test intervention	0,002*	Not normal
	Post-test intervention	0,000*	Not normal
	Pre-test control	0,005*	Not normal
	Post-test control	0,004*	Not normal

* Shapiro-Wilk Test

Table 11 shows the results of the normality test using the Shapiro-Wilk test. In the intervention group, most of the data were not normally distributed ($p < 0.05$), except for the pretest performance variable ($p = 0.409$). In the control group,

the only normally distributed data were posttest knowledge ($p = 0.294$) and posttest attitude ($p = 0.247$), while all other variables were not normally distributed ($p < 0.05$). Based on these results, most of the research data were not normally

distributed. Therefore, the subsequent bivariate analysis used nonparametric tests, namely the Wilcoxon Signed-Rank Test to analyze differences before and after the intervention, and

the Mann-Whitney U Test to compare differences between the intervention and control groups.

Table 12 Effectiveness of the Lia's Dent Website App and Demonstration-Based Health Education

		$\bar{x} \pm SD$		
Variabel	Pre test	Post test	Δ	p-value
Intervention				
Knowladge	8.70±3.13	18.20±1.39	9.50	0,000*
Attitude	32.30±3.79	69.65±4.56	37.35	0,000*
Skills	7.75±2.93	19.50±0.60	11.75	0,000*
Early Detection of Gingivitis	7.05±7.50	0.40±0.94	6.65	0,001*
Control				
Knowladge	7.95±2.56	14.65±1.63	6.70	0,000*
Attitude	31.95±7.20	55.30±5.58	23.35	0,000*
Skills	7.50±1.73	11.20±2.52	3.70	0,000*
Early Detection of Gingivitis	6.70±6.90	6.45±6.49	0.25	0,102*

*Shapiro-Wilk Test

Table 12 shows that the change values (Δ) for the variables of knowledge, attitude, Skills, and early detection of gingivitis—before and after the intervention—in the intervention group that was provided with the Lia's Dent website application were 9.50, 37.35, 11.75; and 6.65, with corresponding p-values from the Wilcoxon test of 0.000;

0.000; 0.000; and 0.001, respectively, or p-values <0.05. These results indicate that the Lia's Dent website application is effective in improving knowledge, attitudes, and Skills regarding oral health maintenance, as well as in improving gingival health through a reduction in early gingivitis detection scores.

Tabel 13 A Comparative Study of the Lia's Dent Website Application and Demonstration-Based Health Education

Variabel	p-value
Knowledge	0,000**
Attitude	0,000**
Skills	0,000**
Early Detection of Gingivitis	0,000**

Mann-Whitney Test**

Table 13 shows the p-values from the Mann-Whitney test for the variables of knowledge, attitude, skills, and early detection of gingivitis, which were 0.000; 0.000; 0.000; and 0.000, respectively, or p-values <0.05. These results indicate that the Lia's Dent website is more effective than demonstration-based health education in improving knowledge, attitudes, and skills regarding oral health maintenance, as well as in improving gingival health through the early detection of gingivitis in pregnant women.

IV. DISCUSSION

➤ Data Systematic Analysis of the Borg and Gall R&D Model, the Technical Advantages of the Laravel Framework, and Data Security

The development of the Lia's Dent website application utilized the Borg and Gall Research and Development model, ensuring that each feature was developed based on the needs of pregnant women through stages of testing and product revision. This approach resulted in an application that better meets user needs compared to development that focuses solely on technical aspects.[13,14,15]

The system design, which utilizes UML, combined with the implementation of the Laravel framework, provides advantages in terms of system stability and user data security.

Supported by a MySQL database, the application is capable of storing daily activity data and evaluation results in an integrated manner, thereby facilitating the monitoring of pregnant women's oral and dental health. These findings align with the development of the SIP-UKGM system, which demonstrates that web-based applications can support real-time health monitoring and assist healthcare professionals in conducting early interventions. [16,17,18]

The choice of a web-based platform also offers convenience because it can be accessed via various devices without the need to install an app. Additionally, updates to educational materials and features can be performed centrally by administrators, ensuring that the information received by users is always up to date. Thus, the web-based platform is considered more flexible, easily accessible, and well-suited to the needs of pregnant women as users of the Lia's Dent app.

➤ Lias Dent Expert Validation

The Lia's Dent website application was evaluated by three validators: an oral health expert (dentist), who gave it a feasibility score of 91.67%; a health promotion expert, who gave it a score of 100%; and an IT expert, who also gave it a score of 100%. The app features oral health education, toothbrushing activity tracking, behavioral questionnaires,

and early gingivitis detection to support improved oral health behaviors among pregnant women.

The validation results revealed several areas for improvement: the website layout is not yet responsive on mobile phones; the questionnaire contains too many questions; the early gingivitis detection feature is not yet accessible to dentists and administrators; and the app's design needs to be adapted to the characteristics of pregnant women. Based on this feedback, revisions were made to refine the layout, simplify the questionnaire, grant additional access rights, and improve the user interface design.

The validity test results showed an Aiken's V value of 0.963, indicating very high content validity, while the ICC value of 0.857 ($p=0.003$) indicated a strong level of agreement among validators. These results indicate that the Lia's Dent website application is suitable for use as a tool for education and early detection of gingivitis in pregnant women. These findings are consistent with the development of the SIP-UKGM and PREDHIS applications, which prioritize expert validation as a critical step before the applications are implemented.[10,16]

➤ Product Result Test

• *The Effectiveness of the Lia's Dent Website App in Improving Knowledge of Oral Health Care Among Pregnant Women*

The results of the analysis showed that the oral health care knowledge score in the intervention group increased by 9.50, from a mean of 8.70 to 18.20, with a Wilcoxon test p -value of $p=0.000$. In the control group, the knowledge score increased by 6.70, from an average of 7.95 to 14.65, with a p -value of 0.000. The results of the Mann-Whitney test showed a p -value of 0.000 ($p < 0.05$), indicating a significant difference in the increase in knowledge between the two groups. Thus, the Lia's Dent website application is more effective than demonstration-based educational media in improving knowledge of oral health care among pregnant women.

The greater increase in knowledge in the intervention group is likely due to the app presenting material systematically, accompanied by illustrative images, and being accessible at any time, allowing users to review the material as needed. This aligns with Edgar Dale's Cone of Experience theory, which states that the use of visual media and more active learning experiences can enhance understanding and retention compared to verbal delivery of information..

The results of this study are consistent with those of Puteri et al. (2026), who reported that digital educational media are more effective at increasing knowledge than conventional media. According to health behavior theory, knowledge is a cognitive domain that forms the basis for attitudes and actions.[19] Therefore, increasing knowledge through the Lia's Dent Website App is expected to encourage pregnant women to adopt better oral health maintenance behaviors.

• *The Effectiveness of the Lia's Dent Website App in Improving Attitudes Toward Oral Health Care Among Pregnant Women*

The results of the analysis showed that the oral health care attitude score in the intervention group increased by 37.35, from a mean of 32.30 to 69.65, with a Wilcoxon test p -value of $p=0.000$. In the control group, the attitude score increased by 23.35, from a mean of 31.95 to 55.30, with a p -value of 0.000. The results of the Mann-Whitney test showed a p -value of 0.000 ($p < 0.05$), indicating that the Lia's Dent website application is more effective at improving attitudes toward oral health maintenance among pregnant women compared to demonstration-based educational media.

The greater improvement in attitudes in the intervention group is likely due to the fact that the Lia's Dent Website Application not only conveys information but also provides educational features, evaluation tools, activity monitoring, and early detection of gingivitis, all of which encourage active user engagement. Materials that can be accessed at any time allow pregnant women to review the information, thereby increasing their awareness and fostering a more positive attitude toward oral health maintenance. This aligns with the Health Belief Model (HBM), which explains that attitudes are influenced by perceptions of disease risk, the benefits of an action, and the motivation to engage in health-promoting behaviors.

The results of this study are consistent with those of Natalia et al. (2023), Fratiwi et al. (2024), and Mohammadkhah et al., who reported that digital educational media are more effective at improving attitudes than conventional media. Digital media that is interactive, easily accessible, and provides feedback can increase user engagement, thereby fostering positive attitudes toward oral health maintenance.[20,21,22]

Thus, the Lia's Dent website application proved to be more effective in improving attitudes toward oral health care among pregnant women compared to demonstration-based educational media. The positive attitudes formed are expected to serve as a foundation for encouraging behavioral changes in oral health care during pregnancy.

• *The Effectiveness of the Lia's Dent Website Application in Improving Oral Health Maintenance Skills Among Pregnant Women*

The analysis results showed that the oral health maintenance Skills score in the intervention group increased by 11.75, from a mean of 7.75 to 19.50, with a Wilcoxon test p -value of $p=0.000$. In the control group, the skill score increased by 3.70, from an average of 7.50 to 11.20, with a p -value of 0.000. The results of the Mann-Whitney test showed a p -value of 0.000 ($p < 0.05$), indicating that the Lia's Dent Website Application is more effective at improving oral health maintenance Skills s and skills among pregnant women compared to demonstration-based educational media.

The greater improvement in skills in the intervention group is likely due to the fact that the Lia's Dent Website Application not only delivers educational content but also provides illustrative images, assessments, activity monitoring, and early detection of gingivitis, which encourages pregnant

women to apply the information in their daily lives. The ease of accessing the material at any time also allows users to review the lessons, making it easier to develop these skills .

These findings align with Edgar Dale's Cone of Experience theory, which states that learning is more effective when learners gain experience through visual media and active engagement rather than simply receiving information verbally. The presentation of material accompanied by illustrations, assessments, and activity monitoring on the Lia's Dent website application provides a more meaningful learning experience, thereby helping pregnant women translate knowledge into concrete action.

These research results are consistent with those of Kurnia et al. (2024) and Riolina et al. (2025), who reported that digital-based educational media are more effective at improving skills because they allow for material review, self-assessment, and active user engagement.[23,24] Therefore, the Lia's Dent Website Application can serve as an effective educational medium for improving oral health maintenance behaviors and skills among pregnant women.

- *The Effectiveness of the Lia's Dent Website Application in Enhancing the Ability to Detect Early Signs of Gingivitis in Pregnant Women*

The analysis results show that the early detection score for gingivitis in the intervention group decreased by 6.65, from an average of 7.05 to 0.40, with a Wilcoxon test significance value of $p=0.001$. This decrease in the score indicates an improvement in gingival condition following the use of the Lia's Dent Website Application. In the control group, the score decreased by only 0.25, from an average of 6.70 to 6.45, and this change was not statistically significant ($p=0.102$). The results of the Mann-Whitney test showed a p -value of 0.000 ($p < 0.05$), indicating that the Lia's Dent Website Application is more effective at improving the ability to detect early signs of gingivitis in pregnant women compared to demonstration-based educational media.

The improvement in early detection ability in the intervention group is likely due to the fact that the Lia's Dent Website Application not only provides educational materials but also includes a gingivitis early detection feature, enabling pregnant women to recognize early signs such as bleeding gums, swelling, and changes in gum color. The ease of accessing information and performing self-assessments helps raise awareness of oral health conditions.

These findings are consistent with the Health Belief Model (HBM), which explains that individuals are motivated to take preventive actions when they perceive the risks and consequences of a disease. Through its early detection feature, the app helps raise awareness among pregnant women about the risks of gingivitis, thereby encouraging early prevention efforts.

These research results align with those of Sittatunnikmah et al. (2024), the developers of the Pregnant Dental Health Information System (PREDHIS) app, as well as the study by Ramdhani et al. (2023) on Oral Detect-Tri, which demonstrated that digital media effectively improves the

ability to detect dental and oral diseases early through education and self-screening.[10,25] Therefore, the Lia's Dent website application can serve as an effective tool for improving the ability to detect early signs of gingivitis in pregnant women.

V. LIA'S DENT WEBSITE APPLICATION PRODUCT

The product developed in this study is the Lia's Dent Website Application, a web-based educational tool designed to improve oral health maintenance behaviors and support the early detection of gingivitis in pregnant women. This application can be used independently by pregnant women or by healthcare professionals through two types of user access.

For pregnant women, the application provides login features, a pre-test, educational materials on oral health during pregnancy, a post-test, monitoring of daily toothbrushing activities, and user profile management. Meanwhile, for healthcare professionals, the app is equipped with a dashboard, patient data management, monitoring of patients' daily activities, educational material management, evaluation of pre-test and post-test results, questionnaire management, and a feedback menu.

Overall, the Lia's Dent website integrates education, monitoring of oral health maintenance behaviors, and early detection of gingivitis into a single digital platform, making it easier for pregnant women and healthcare professionals to promote and monitor oral health during pregnancy.

VI. CONCLUSION

Based on the research findings, the Lia's Dent Website Application was successfully developed as an effective oral health education tool for pregnant women. The application's development was based on a literature review and the collection of user needs data, resulting in a platform capable of integrating education, monitoring of oral health maintenance behaviors, and early detection of gingivitis into a single web-based platform.

The research results also indicate that the Lia's Dent Website Application is more effective than demonstration-based educational methods in improving oral health maintenance behaviors among pregnant women. This effectiveness is demonstrated by significant improvements in knowledge, attitudes, actions or skills related to oral health maintenance, and the ability to detect gingivitis early. The results of the Mann-Whitney test showed that there were statistically significant differences between the intervention group and the control group across all variables, namely knowledge ($p=0.000$), attitudes ($p=0.000$), actions/skills ($p=0.000$), and the ability to detect gingivitis early ($p=0.000$), with all p -values <0.05 . These findings indicate that the Lia's Dent Website Application is an effective digital educational tool for improving oral health maintenance behaviors and the ability to detect gingivitis early in pregnant women.

REFERENCES

- [1]. Marla V, Srii R, Roy DK, Ajmera H. The Importance of Oral Health during Pregnancy: A review. *Medical Express*. 2018;5. doi:10.5935/MedicalExpress.2018.mr.002
- [2]. Ahza L, Budiman JA, Asia RrA. Hubungan Pengetahuan Kesehatan Gigi dan Mulut Terhadap Kualitas Hidup Lanjut Usia. *ARTERI Jurnal Ilmu Kesehatan*. 2024;6(1):47-54. doi:10.37148/arteri.v6i1.454
- [3]. Indarto PA, Priyono B, Widyanti N. Faktor-faktor yang Mempengaruhi Perilaku Pemeliharaan Kebersihan gigi dan Mulut Ibu Hamil di Puskesmas Kabupaten Kupang. *Journal of Dental Therapist*. 2014;21(1):20. doi:10.22146/majkedgiind.8465
- [4]. Sulha SA, Hadi S, Mahirawati IC. Hubungan Pengetahuan Pemeliharaan Kesehatan Gigi Dan Mulut Ibu Hamil K1 Dengan Gingivitis. *Journal of Authentic Research*. 2025;4(Special Issue):900-911. doi:10.36312/jar.v4iSpecialIssue.3285
- [5]. Umniyati H, Amanah SP, Maulani C. Hubungan gingivitis dengan faktor-faktor risiko pada ibu hamil. *Padjadjaran Journal of Dental Researcher and Student*. 2020;3(2). doi:10.24198/pjdrs.v3i2.26086
- [6]. Chen P, Li M, Zhang Q, Qiu M, Yu X. Effects of an Oral Health Management Program During Pregnancy: A Randomized Controlled Trial. *Oral Diseases*. Published online September 7, 2025:odi.70076. doi:10.1111/odi.70076
- [7]. Alfianita A, Edi IS, Isnanto I. Kejadian Gingivitis Pada Ibu Hamil Ditinjau Dari Faktor Hormon, Perilaku Dan Lokal. *JKGM*. 2021;3(2):41-46. doi:10.36086/jkgm.v3i2.932
- [8]. Dewi HP, Adnan S, Erawati S. Faktor risiko karies gigi pada ibu hamil. *Prima Journal of Oral and Dental Sciences*. 2023;6(6):6–10. Available from: <http://jurnal.unprimdn.ac.id/index.php/PrimaJODS>
- [9]. Karamoy Y, Fione VR. Penggunaan Kartu Sehat Gigi Ibu Hamil (Kasih) Sebagai Instrumen Penilaian Risiko Penyakit Periodontal Dan Karies Ibu Hamil Di Kota Manado. *JIGIM (Jurnal Ilmiah Gigi dan Mulut)*. 2020;3(1):8-14. doi:10.47718/jgm.v3i1.1428
- [10]. Sittatunnikmah A, Sunarjo L, . S. Developing and Testing PREDHIS (Pregnant Dental Health Information System): A Self-Detection Tool for Oral Disease Risk Factors in Pregnant Women. *IJISRT*. Published online April 2, 2024:1813-1820. doi:10.38124/ijisrt/IJISRT24MAR1429
- [11]. Indri Ardiyanti I, Supriyana, Eko Ningtyas EA, Daniati N. “Tan’s Dent-Card Qr Model Website Based” as an Effort to Improve Teeth Brushing Behavior and Dental Hygiene Status Primary School Children. *IJISRT*. 2024;9(7):515-520. doi:10.38124/ijisrt/IJISRT24JUL253
- [12]. Indri Ardiyanti I, Supriyana, Eko Ningtyas EA, Daniati N. “Tan’s Dent-Card Qr Model Website Based” as an Effort to Improve Teeth Brushing Behavior and Dental Hygiene Status Primary School Children. *IJISRT*. 2024;9(7):515-520. doi:10.38124/ijisrt/IJISRT24JUL253
- [13]. Dharma BA, Septiana A. The Use of WIX as a Learning Media to Support Self-regulated Learning and Learning Activity. In: Kurniawan DT, Zutiasari I, eds. *Proceedings of the BISTIC Business Innovation Sustainability and Technology International Conference (BISTIC 2022)*. Vol 245. *Advances in Economics, Business and Management Research*. Atlantis Press International BV; 2023:347-356. doi:10.2991/978-94-6463-178-4_35
- [14]. Zustiyanoro D, Putro RTH, Nugraha LH. Pengembangan Web Persatuan Pedalangan Indonesia (Pepadi) Jawa Tengah sebagai Upaya Promosi Seni Tradisi. *Varia Humanika*. 2021;2(1):86-93. doi:10.15294/vh.v2i1.42549
- [15]. Lufthansa L, Saputro YD, Rohmah LN, Yusuf H, Artanty A. Analisis Kebutuhan Pengembangan Bahan Ajar Elektronik Mata Kuliah Penjas Adaptif Di Ikip Budi Utomo. *J Sport Sci Fit*. 2022;8(1):23-32. doi:10.15294/jssf.v8i1.58141
- [16]. Nuraeni N, Sunarjo L, Sutomo B. Web-based Community Health Monitoring Information System (SIP-UKGM) for Pregnant Women. *IJISRT*. Published online August 9, 2024:2415-2422. doi:10.38124/ijisrt/IJISRT24JUL1836
- [17]. Nawali J, Ivtari Savika H, Kharismatul Mufidah I, Susilawati S. Pengembangan Media Pembelajaran Di Mi Dan Sd. *Cahaya J Res Sci Educ*. 2024;2(1):37-49. doi:10.70115/cahaya.v2i1.133
- [18]. Pitnawati P, Damrah D, Gusti Handayani S, Naza Putra A, Sasmittha W. Development of direct and indirect assistance approach using jigsaw method and android-based digital design method for gymnastic materials. *J Phys Educ Sport*. 2023;23(12). doi:10.7752/jpes.2023.12376
- [19]. Puteri AG, Fatmasari D, Sutomo B. A Patient-Centered Oral Health Care Model for Enhancing Knowledge, Treatment Compliance, and Anxiety Management in Patients with Irreversible Pulpitis. *Int J Innov Sci Res Technol*. Published online April 10, 2026:3823. doi:10.38124/ijisrt/26mar1967
- [20]. Natalia, Sunarjo L, Djamil M. Utilization Of Augmented Reality E- Pregnant As Educational Media For Improving Prevention Of Behavior Caries In Pregnant Mothers. *Journal Health Sains*. 2023;4(5). doi:https://doi.org/
- [21]. Fratiwi W, Kristiani A, Anang A. Efforts to Improve Knowledge, Attitudes and Behaviors about Dental and Oral Health Through the Use of TikTok App for Pregnant Women. *J Cent Excell Health Assist Technol*. 2024;2(2):119-122. doi:10.36082/jchat.v2i2.1870
- [22]. Mohammadkhah F, Amirhajelu RM, Bakhtiar M, Salemi SA, Kevenjan M, Jeihooni AK. The effect of training intervention based on the theory of planned behavior on oral and dental health behaviors in pregnant women. *BMC Oral Health*. 2023;23(1):521. doi:10.1186/s12903-023-03239-w
- [23]. Aprianti K, Djamil M, Ningtyas EAE. Kurnia’s Web-Based Drill Method Can Measure the Level of Toothbrushing Skills of Blind Children. *Jurnal Kesehatan Gigi*. 2024;11(1):19-25. doi:10.31983/jkg.v11i1.10261

- [24]. Riolina A, Yulian V, Sukin S, et al. Mobile-Based Oral Health Self-Screening and Education Application for Pregnant Women. *J Kesehatan Gigi*. 2025;12(1):176-182. doi:10.31983/jkg.v12i1.13014
- [25]. Ramdhani A, Fatmasari D, Djamil M. Oral Detect-Tri To Improve Dental And Oral Diseases Detection Behaviour In Houswives. *JDHT*. 2023;4(2):132-139. doi:10.36082/jdht.v4i2.1276