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Development of a Chatbot Application Model on the Intention and Knowledge of Pregnant Women in Dental Visit

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Abstract: Oral health during pregnancy is a crucial aspect of maternal well-being, yet awareness of the importance of dental visits among pregnant women remains low. Hormonal changes, behavioral factors, and limited access to information contribute to an increased risk of oral health problems, which can affect both the mother and the fetus. In the era of Society 5.0, Android-based chatbot technology integrated with public health centers (Puskesmas) offers a promising approach to health education. This study aimed to develop and assess the effectiveness of a chatbot application in improving pregnant women's intention and knowledge regarding dental visits. A Research and Development (R&D) method was applied using a simplified Borg and Gall model, consisting of stages including information gathering, application design, expert validation, a small-scale trial with 7 respondents, and large-scale testing with 30 respondents using a one group pretest-posttest design. Validation by experts showed that the application had high validity (Aiken's V > 0.8) and strong reliability (ICC, p = 0.001). The effectiveness test demonstrated a significant increase in both intention and knowledge scores after the intervention (p = 0.000). These results confirm that the chatbot application is a feasible and effective digital education tool to promote routine dental visits during pregnancy.

Keywords: *Chatbot Application, Intention, Knowledge, Dental Visit.*

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I. INTRODUCTION

Oral health is an important part of overall health. The WHO emphasizes that dental health should be an integral part of the primary health care system to ensure equitable access [1]. In Indonesia, various efforts have been made by the government to improve oral health services for all age groups, including pregnant women. Despite this, the prevalence of dental caries in Indonesia is still high, reaching 88.8%, with only 2.8% of people brushing their teeth properly and 95.4% not having their teeth examined by a medical professional [2]. The Indonesian Health Survey (SKI) data also noted that 61.1% of people did not go to the dentist because they felt their teeth did not hurt [3].

The low utilization of dental health services is influenced by various factors, such as knowledge, attitudes, perceptions, and access to information obtained. In addition, the low motivation of the community in utilizing dental and oral services is also an obstacle. The lack of understanding and trust in medical services causes some people to prefer traditional medicine [4]. This condition reflects that the utilization behavior of dental health services is still not optimal. In this case, the Theory of Planned Behavior (TPB) is a relevant theory, because it explains that a person's intention to take action is influenced by intention, which is formed from attitudes towards behavior, subjective norms, and perceived behavioral control [5].

One of the vulnerable groups that require special attention to oral health is pregnant women. During pregnancy, hormonal changes increase the risk of dental health problems such as gingivitis, caries and periodontitis. Routine dental care during pregnancy has been shown to be effective in reducing the risk of premature and low birth weight babies by up to 68%. But in reality, the level of awareness and visits of pregnant women to dental health care facilities is still relatively low [6].

Pregnant women's intention to visit the dental clinic is influenced by the information they have, which is included in the background factor in TPB. Effective information delivery is key in shaping these intentions [5]. Audio-visual-based media is proven to be able to increase the absorption of health information, especially in the Society 5.0 era which emphasizes the integration of humans and technology. The utilization of telehealth, including NLP-based chatbots, offers an interactive and responsive solution in bridging access limitations and increasing oral health literacy in pregnant women [7].

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The results of a preliminary study conducted at Puskesmas Gunungpati, Semarang showed that the visit rate of pregnant women to the dental clinic was still very low at 15.9 in January and 16.7% in February. The majority of pregnant women do not understand the importance of dental examinations during pregnancy and only visit when scheduled in conjunction with the antenatal care (ANC) program. Based on these conditions, a chatbot application model integrated with Puskesmas was developed as a digital education media that aims to increase the intention and knowledge of pregnant women on the importance of visiting the dental clinic independently.

II. RESEARCH METHODS AND SAMPLE

This research uses the Research and Development (R&D) method by adapting a simplified Borg and Gall model, including several main stages: information gathering, product design, expert validation and revision, product trials and preparation of the final product [8]. The product developed is an oral health education chatbot application as an effort to change the intention and increase the knowledge of pregnant women in making visits to the dental clinic.

The initial stage of information gathering was carried out to identify problems in the field that would form the basis for application development. Data was obtained through observation, interviews, and systematic literature review to strengthen existing empirical findings.

The application design uses the System Development Life Cycle (SDLC) model of the waterfall method, which consists of five stages: requirements, design, implementation, verification, and maintenance. This design resulted in an initial prototype of a chatbot application that was ready to be validated.

The expert validation stage involved three experts according to the fields relevant to application development, namely media experts, dental health promotion experts, and information technology experts. The assessment was carried out using a questionnaire containing 10 statement items with a Likert scale of 1-4 (1: Strongly Disagree to 4: Strongly Agree). The validation process refers to the ISO 9126 software quality standard, which includes six aspects: functionality, reliability, usability, efficiency, maintainability, and portability. Validation analysis was conducted using Aiken's V test, while reliability was assessed using the Intraclass Correlation Coefficient (ICC).

After validation, a limited trial of the application was conducted using the pre-experiment method through a one group pretest and posttest design. The sample was selected using total sampling technique, involving 7 pregnant women respondents. The trial procedure includes:

- Respondents filled out informed consent as approval for participation in the study.
- Installed the application through the link provided by the researcher.
- Completed a pretest questionnaire to measure intention and initial knowledge.
- Using the app for 21 days, with a minimum frequency of nine accesses within the period.
- Completed the posttest questionnaire and checklist sheet to evaluate changes in intention and knowledge after the intervention.

Data from the pilot test were analyzed descriptively because the number of samples did not meet the requirements for inferential statistical analysis. The results of this trial became the basis for consideration for a larger scale implementation in order to assess the success and suitability of the chatbot application as a self-education medium for pregnant women. All analyses were conducted using an analytic descriptive approach.

III. RESULTS

➢ *Information Collection Result*

From the results of interviews, it is known that education related to dental health during pregnancy is still not a top priority in antenatal care (ANC) services, and there is no digital educational media that can be accessed independently by pregnant women. The education provided is still conventional such as direct counseling, which is considered less effective and does not reach all pregnant women. Meanwhile, a literature review shows that low knowledge and intention of pregnant women in maintaining dental health is a common problem that also occurs in various regions. Several studies provide various educational methods or media as innovative solutions, especially approaches such as chatbots. These findings became an important basis for formulating user requirements and designing the initial features in the developed application.

➢ *Chatbot Application Model Design*

The design of the oral health education chatbot application for pregnant women is carried out using the System Development Life Cycle (SDLC) approach of the waterfall model, which consists of five stages: 1. The requirement stage, compiled based on the results of collecting information from user needs. 2. Design stage, chatbot conversation flow, menu structure, and interface that is simple and easy to use for pregnant women. 3.

The implementation stage, carried out by building an android-based application using the appropriate programming language and platform. 4. Verification stage, carried out through the process of testing functionality and navigation to ensure all features go according to plan. 5. Maintenance stage, the system is already running and improvements are made that were not found before.

The final result of this process is a chatbot application for pregnant women, which has a main menu containing pregnancy information related to dental health, educational conversations and videos, and consultation features. This application will be integrated to the health center in the region.

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➢ *Expert Validation*

The feasibility test of the chatbot application was carried out by 3 expert validators, namely, media experts, dental health promotion experts, information technology experts. The validation process uses a questionnaire instrument consisting of 10 statements. The results of the data were analyzed using the Aiken V validity test and the Intraclass Correlation Coefficient (ICC), which can be seen in the following table:

- *Validity Test*

Table 1 Expert Validation

No.	Test Result	Interpretation	Follow Up
1	0,44	Moderate Validity	Accepted/used
2	1,00	High Validity	Accepted/used
3	0,88	High Validity	Accepted/used
4	0,77	Moderate Validity	Accepted/used
5	0,88	High Validity	Accepted/used
6	1,00	High Validity	Accepted/used
7	0,66	Moderate Validity	Accepted/used
8	1,00	High Validity	Accepted/used
9	0,77	Moderate Validity	Accepted/used
10	1,00	High Validity	Accepted/used
Average Total Rating 0,84			

Based on table 1, the results of the assessment of 3 expert validators, it is known that the results of the expert validation test obtained an average feasibility of 0.84 are declared very valid (V hit> 0.8).

- *Reliability Test*

Table 2 Expert Validation

	Interclass Correlation[b]	Sig
Single Measure	.595[a]	.001
Average Measure	.815[c]	.001

The results of table 2 of the reliability test show that validation by one expert shows a single measure value of 0.595, this value is >0.50, so the reliability has adequate r. Meanwhile, the overall results from the three experts show an Interclass Correlation value of 0.815, this value is >0.80 so it can be concluded that the application has high reliability.

➢ *Model Trial Testing*

Table 3 Respondent Characteristics Data (Trial Testing)

No.	Characteristic	n	%
1.	Education		
	SD	0	0
	SMP	0	0
	SMA	2	28,6
	Bachelor	5	71,4
2.	Gestational Age		
	Trimester 1	1	14,3
	Trimester 2	4	57,1
	Trimester 3	2	28,6

Table 3 shows the frequency distribution of characteristics of pregnant women based on their latest education and gestational age. The majority of respondents had the last level of education Bachelor with a percentage of 71,4% (5 people). Meanwhile, based on gestational age, most respondents were in the second trimester, which amounted to 57.1% (4 people).

Table 4 Frequency Distribution of the Average of the Model Trials

Variable	Mean ± SD *Pre Test*	Mean ± SD *Post Test*	Delta (Δ) ± SD
Intention of Pregnant Women	12,57 ± 3,207	24 ± 1,414	11,43 ± 4,036
Knowledge of Pregnant Women	10 ± 1,414	12,57 ± 0,535	2,57 ± 1,512

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Table 4 shows an increase in the average score on the intention and knowledge variables after the chatbot application intervention. The average intention score increased from 12.57 (pre-test) to 24 (post-test), while knowledge increased from 10 to 12.57. The mean difference of 11.43 for intention and 2.57 for knowledge showed that the intervention had a positive impact on increasing respondents' intention and knowledge.

➢ *Application Model Result*

Table 5 Respondent Characteristics Data (Model Result)

No.	Characteristic	N	%
1.	Education		
	SD	5	16,7
	SMP	7	23,3
	SMA	12	40
	Sarjana	6	20
2.	Gestational Age		
	Trimester 1	8	26,7
	Trimester 2	12	40
	Trimester 3	10	33,3

Table 5 shows the frequency distribution of pregnant women based on their latest education and gestational age. Most of the pregnant women had a senior high school education level, which was 40% (12 people). Based on gestational age, most respondents were in the second trimester with the same percentage, namely 40% (12 people).

➢ *Normality Test*

The test is conducted to determine whether the data for each variable is normally distributed. The Shapiro-Wilk method was used because the number of samples was less than 50.

Table 6 Normality Test of Pre-Post Test Data of Pregnant Women's Intention and Knowledge

Variable	Intervention	Interpretation
Pre Test Intention	0,013	Abnormal
Post Test Intention	0,016	Abnormal
Pre Test Knowledge	0,000	Abnormal
Post Test Knowledge	0,000	Abnormal

Table 6 shows the results of the normality test on the pre-test and post-test data of the intention and knowledge variables. The significance value (p) <0.05 indicates that the data is not normally distributed. Therefore, the analysis continued with a non-parametric test using the Wilcoxon test.

Table 7 Results of the Test of the Effectiveness of Pregnant Women's Intention and Knowledge

Variable	Mean ± SD *Pre Test*	Mean ± SD *Post Test*	Delta (Δ) ± SD	*p-value**
Intention of Pregnant Women	15,83 ± 3,086	22,47 ± 2,662	6,63 ± 3,368	0,000
Knowledge of Pregnant Women	10,1 ± 0,923	12,27 ± 0,521	2,17 ± 0,913	0,000

Table 7 shows an increase in the mean scores on the intention and knowledge variables after the intervention. The average intention score increased from 15.83 to 22.47 with a mean difference (Δ) of 6.63 and a p-value of 0.000 (p<0.05), indicating that the chatbot application was effective in increasing pregnant women's intention to visit the dental clinic. On the knowledge variable, the mean score increased from 10.1 to 12.27 with a mean difference (Δ) of 2.17 and a p-value of 0.000 (p<0.05), so the application was also proven effective in increasing pregnant women's knowledge related to dental visits.

IV. DISCUSSION

➢ *Chatbot Application Information Collection*

Information was collected through observation, interviews, and systematic literature review. Observations were conducted in the working area of Puskesmas Gunungpati, Semarang, while interviews involved health workers such as midwives, dentists and dental therapists. From the observations and interviews, it was found that visits by pregnant women to the dental clinic were still relatively low. This condition reflects the lack of attention to oral health during pregnancy, which is an important aspect in maintaining maternal and fetal health. One of the main factors underlying the low visit rate.

In addition, there is no educational media that is easily accessible, attractive, and tailored to the characteristics of pregnant women in the region. One-way education, limited to conventional counseling or through health workers during dental examinations, has not been effective in raising awareness and encouraging behavior change. As a result, most pregnant women will only visit the dental clinic when they have complaints of pain, swelling, or other emergency conditions. The low initiative to conduct dental examinations independently in conditions without complaints reflects the need for a more interactive, sustainable and contextualized educational approach [9].

These results are the basis for the development of innovative educational media such as an android-based

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chatbot application, which is expected to reach more pregnant women, provide two-way interactive education, and increase awareness of the importance of regular dental visits, not just when there are complaints.

➢ *Chatbot Application Design and Expert Validation*

Pregnancy has a significant impact on oral health due to hormonal changes, such as increased estrogen and progesterone which can trigger plaque and caries. Nausea and vomiting also increase oral acidity, which risks causing nutritional disorders, premature birth, and low birth weight [10]. In the era of Society 5.0, the utilization of technologies such as remote health services and AI-based chatbots is growing. Chatbots are able to provide quick information, easy consultation, and improve the efficiency of health services [11]. The chatbot application developed in this study provides dental education features for pregnant women, including chatbot 's menu, educational videos, and consultation photos. The application has been validated by media, health promotion, and IT experts, with the results of the Aiken V validity test and ICC reliability test showing high values. Thus, the application was declared valid and suitable for field trials as an educational media to increase the intention and knowledge of pregnant women in maintaining oral health.

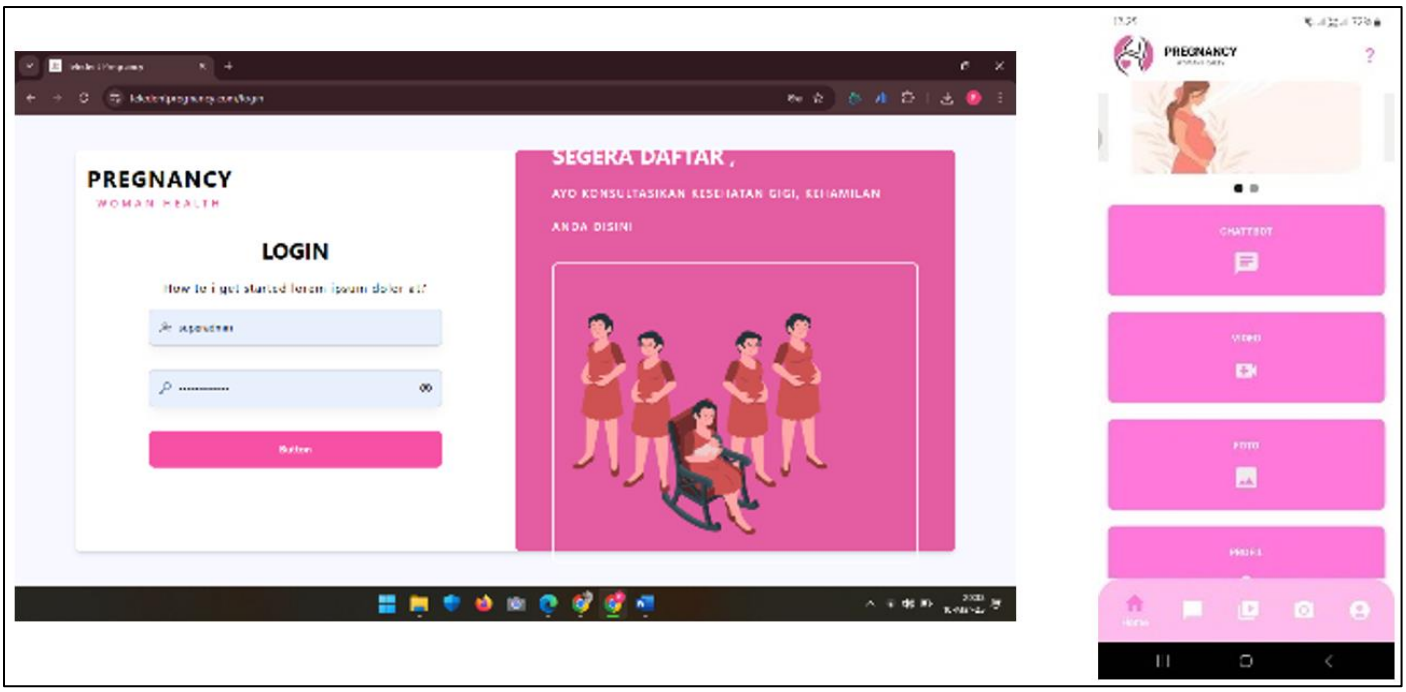

Fig 1 Chatbot Application Model Development (User) and Tele Dentistry Web (Admin)

➢ *Chatbot Application Model Trial*

A small group trial was conducted with seven pregnant women at Puskesmas Gunungpati, Semarang, as an initial stage to assess the potential of the chatbot application in increasing intention and knowledge related to dental visits. The majority of respondents had a Bachelor's degree, and most were in their second trimester. Descriptive analysis showed an increase in the mean score of intention from 12.57 to 24 (11.43 difference), and knowledge from 10 to 12.57 (2.57 difference). This finding indicates that the chatbot application has a positive impact in increasing the intention and knowledge of pregnant women. Although statistical tests have not been conducted, the chatbot proved to be able to attract attention and increase user engagement. Previous research supports that interactive digital educational media is effective in delivering information that is easy to understand and as needed [12]. Therefore, further trials on larger groups are needed to statistically strengthen the evidence of the app's effectiveness.

➢ *Product Result Test*

After passing the development stage and initial trials in small groups, the next stage is to test the product on a wider scale. This test aims to evaluate the final effectiveness of the chatbot application as a medium for oral health education for pregnant women. A total of 30 pregnant women respondents were involved in this test as part of the finalization process to assess the impact of the intervention provided.

- *Test of the Effectiveness of Pregnant Women's Intention of Visit Dental Clinic*

This study aims to determine the effectiveness of chatbot applications in increasing the intention of pregnant women to make visits to the dental clinic during pregnancy. Tests were conducted on 30 pregnant women respondents using pre-test and post-test statistical tests on the intention variable. The test results showed a significant increase, from an average score of 15.83 to 22.47, with a p-value of 0.000 ($p<0.05$), which indicated that the intervention through the chatbot application was effective in increasing the intention of pregnant women.

The characteristics of the respondents showed that most of the pregnant women had a medium to high level of education, with the distribution of gestational age mostly in the second trimester of 12 people, the third trimester of 10 people, and the first trimester of 8 people. These characteristics illustrate that pregnant women with a relatively good level of education and are in the active phase

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of pregnancy (second trimester) are easier to absorb information and respond to education provided through the application, thus supporting the effectiveness of the intervention.

The increase in intention that occurs can be explained through the Theory of Planned Behavior (TPB) approach proposed by Ajzen. According to this theory, information acts as a background factor that forms three main components in behavioral intentions, namely attitudes towards behavior, subjective norms, and perceived behavioral control [13]. In this context, the chatbot application acts as an information medium that is able to form a positive attitude towards dental examinations through educational content. The consultation feature with health workers supports the formation of positive subjective norms, while the ease of accessing information flexibly through chatbots increases the perceived control of pregnant women towards dental examination behavior.

With the delivery of information that is relevant, easy to understand, and in accordance with the needs of the target, this application not only functions as an educational medium, but also as a facilitator of behavior change. Interactive features such as direct questions and answers with dentists increase the confidence of pregnant women in making decisions to conduct dental examinations during pregnancy.

The effectiveness of TPB-based interventions in improving attitudes, subjective norms, perceived control, intentions, and oral health behaviors has been proven in various forms of education before, such as group discussions, videos, pamphlets, and direct practice. In this study, a chatbot application was designed to provide information interactively, flexibly, and with a consultation feature that makes it easy for pregnant women to get support whenever needed. [14].

These results are also in line with previous research which shows that chatbot-based educational media is effective in delivering health information, and can be integrated into health management systems to support preventive services. Digital technology is proven to increase the involvement and participation of pregnant women in efforts to maintain health during pregnancy, especially in promotive and preventive aspects of oral health. Thus, increasing the intention of pregnant women to conduct dental examinations during pregnancy through the use of chatbot applications has a positive impact on the prevention of dental and oral diseases, and contributes to improving the overall quality of maternal and fetal health.

- *Test of the Effectiveness of Pregnant Women's Knowledge of Visit Dental Clinic*

The knowledge test in this study aims to assess the effectiveness of chatbot applications in increasing pregnant women's understanding of the importance of dental examinations during pregnancy. Measurement was carried out through pre-test and post-test approaches. The statistical test results showed a significant increase in the mean score of knowledge, from 10.1 to 12.27 with a p-value of 0.000 ($p<0.05$), which indicated that the intervention through the chatbot application was effective in increasing the knowledge of pregnant women.

Further analysis showed that on question number 5, which relates to the ideal timing of dental check-ups during pregnancy, misconceptions were still found. A total of 96.6% of respondents answered incorrectly in the pre-test. The majority of respondents had secondary education (40%) and were in their second trimester (40%). This shows that education level and gestational age affect the understanding of specific information conveyed in education [15].

This was reinforced by interviews, which revealed that low knowledge was due to the lack of available information. Many pregnant women only visit the dental clinic when referred or when complaints arise, and there is no special educational media available regarding dental health during pregnancy. A chatbot application designed with text- and video-based educational materials, and equipped with interactive features for direct consultation with medical personnel, makes a real contribution to improving the understanding of pregnant women, especially for those who have limited access to health services.

This study is in accordance with previous studies that show the limited knowledge of pregnant women about visiting the dental clinic, although some already have a good understanding. High knowledge is not always directly proportional to visiting behavior, but it remains an important component in shaping awareness [16]. Therefore, chatbot applications have great potential as a digital education medium in improving the dental health literacy of pregnant women, as well as supporting promotive and preventive efforts.

V. CONCLUSION

The development of the chatbot application model is feasible to use as a medium for oral health education for pregnant women. This feasibility is proven through the results of expert testing using the Aiken V test with a very high validity category and the ICC test which shows a high level of reliability. The chatbot application is effective in increasing the intention and knowledge of pregnant women regarding the importance of visiting the dental clinic. This application has advantages in the form of easy access, interactive displays, and consultation features that can help pregnant women understand information appropriately. This makes the chatbot application a practical, innovative, and relevant educational media to support dental health promotive services during pregnancy.

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