

Development of a Web-Based E-UKGM Application to Improve the Performance of Oral Health Cadres (A Study in the Padangsari Community Health Center Service Area, Semarang City)

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Abstract: **Background:** The implementation of the Community Dental Health (UKGM) continues to face challenges in recording, reporting, and monitoring activities, which are predominantly conducted manually, resulting in suboptimal program implementation. In addition, the utilization of digital technology to support UKGM implementation by community dental health cadres remains limited. These conditions prompted the development of the E-UKGM web-based application as a supporting tool for implementing UKGM activities. **Objective:** To develop the E-UKGM web-based application and to analyze its feasibility and effectiveness in improving the performance of community dental health cadres in implementing UKGM activities. This study employed a Research and Development (R&D) approach using a modified Borg and Gall model, with system development based on the Waterfall method. The effectiveness of the application was evaluated using a pre-experimental design with a one-group pretest-posttest design. The study involved 30 community dental health cadres selected through total sampling. Feasibility was assessed through expert validation using Aiken's V and the Intraclass Correlation Coefficient (ICC), while effectiveness was analyzed using the Wilcoxon Signed-Rank Test. The web-based E-UKGM application obtained an average expert validation score of 93.33%, categorized as highly feasible, with an Aiken's V value of 0.92 and an ICC value of 0.950. The results of the Wilcoxon Signed Rank Test showed a difference in the performance of community dental health cadres before and after the use of the web-based E-UKGM application in the aspects of dental health education, basic oral health examination, and activity reporting, with $p = 0.000$ for all aspects ($p < 0.05$). The E-UKGM web-based application was found to be highly feasible based on expert validation and effective in improving the performance of community dental health cadres in implementing UKGM activities, particularly in dental health education, basic oral health examination, and activity reporting.

Keywords: E-UKGM, Website, Cadre Performance, UKGM.

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I. INTRODUCTION

One of the government's strategies for improving the public's oral health is through the Oral Health Program (UKGM), which designates health cadres as the primary implementers of promotive and preventive activities at the village level. [1] These cadres play a crucial role in conducting oral health education, identifying target populations, documenting activities, and reporting to community health centers (puskesmas) to support program monitoring and evaluation. [2]

However, in practice, the implementation of UKGM in the field still faces various challenges. The system for recording and reporting activities is still manual and paper-based, resulting in data that is often incomplete, outdated, and difficult to trace for evaluation purposes. In addition, limited health personnel, suboptimal use of information technology, and limited access to an integrated recording system have prevented the program's monitoring and evaluation processes from functioning effectively. These conditions have resulted in suboptimal performance by community health workers in carrying out UKGM activities. [3]

Based on a preliminary study in Padangsari Village, Semarang City, it was found that the recording of UKGM cadres' activities is still done manually, reporting has not been digitally integrated, and the use of information technology in implementing the UKGM program remains limited. These conditions have prevented the community health center from conducting monitoring effectively and sustainably.

The use of information technology in the UKGM program is still not optimal, particularly regarding the recording and reporting of volunteer activities, which are still done manually. This situation results in unintegrated data and complicates the monitoring process. Therefore, a digital innovation in the form of a web-based E-UKGM application is needed to improve the effectiveness of UKGM implementation. [4]

These conditions highlight the need for an innovative information system capable of supporting the recording, reporting, and monitoring of UKGM activities in a more effective and integrated manner. In line with Indonesia's 2021–2024 Digital Health Transformation agenda, the use of a web-based system is one potential solution due to its advantages in accessibility, real-time data integration, and ease of information management.

The web-based E-UKGM application was developed as an information system designed to support community health workers in implementing UKGM. This application enables community health workers to collect data on target populations, record activities, and submit reports in an integrated manner with community health centers. With this structured and digitized system, it is hoped that the performance of community health workers in implementing UKGM will improve. [5]

Although various health applications have been developed, research specifically examining the effectiveness of web-based information systems in improving the performance of UKGM cadres at the community level remains limited. Therefore, research is needed that not only develops the E-UKGM application but also tests the effectiveness of its use in enhancing the performance of cadres in implementing UKGM. [6]

II. RESEARCH METHODS AND SAMPLE

This study employed a Research and Development (R&D) approach aimed at creating, developing, and testing the effectiveness of a web-based E-UKGM application as a support tool for dental health cadres at the Padangsari Community Health Center in Semarang. The development model used is a modification of the Borg and Gall model, carried out through six main stages: information gathering, application design and development, expert validation and product revision, field testing, product revision and refinement, and effectiveness testing.

Data collection was conducted through in-depth interviews, observations, and a focus on user needs and challenges, with validation performed via a questionnaire based on the ISO 9126 standard to assess usability, reliability,

functionality, efficiency, and maintainability. The application's effectiveness was tested using a pre-experimental design with a one-group pretest-posttest approach, in which the performance of community health workers was measured before and after using the application via observation sheets and analyzed using the Wilcoxon Signed-Rank Test.

The study population consisted of dental health cadres actively conducting UKGM activities within the service area of the Padangsari Community Health Center, Banyumanik Subdistrict, Semarang City. The sample was selected using total sampling, meaning all cadres who met the inclusion criteria and were willing to participate in training and application testing—a total of 30 people. Additionally, the validators consisted of three experts from the fields of dental and oral health, information systems, and public health programs, who played a role in the product validation process.

III. RESULTS

A. Web-based E-UKGM Information Collection Result

Data collection for this study was conducted through observation, interviews, and a preliminary study of the implementation of Oral Health Program (UKGM) activities in Padangsari Village, Semarang City. The purpose of data collection was to identify the needs of oral health cadres regarding the development of a web-based E-UKGM application to support the implementation of UKGM activities.

Based on the results of field observations, the implementation of UKGM activities still faces several obstacles, particularly in the process of recording and reporting cadres' activities, which is still done manually using logbooks. This situation results in activity data that is often disorganized, requires a long time to compile reports, and carries the risk of data loss. In addition, monitoring of cadres' activities by community health centers has not been carried out optimally due to the lack of an integrated digital system.

Information was also collected through interviews with the Head of the Community Health Center (R1), dental health personnel consisting of dentists and dental nurses (R2), and dental health volunteers (R3). The interview results also showed that volunteers still face several challenges in implementing UKGM activities, particularly regarding knowledge, skills, and the process of recording and reporting activities, which are still done manually. In addition, the volunteers need educational materials that are easily accessible and can help improve their understanding of oral health and the implementation of UKGM activities in the community.

Most of the interviewees also expressed support for the development of a web-based E-UKGM application as a digital innovation to assist health workers in carrying out UKGM activities. The application is considered capable of supporting the process of activity documentation, target data collection, activity monitoring, the provision of oral health educational materials, and the reporting of activities to community health centers in a more effective and integrated manner.

B. Model Design and Development

The researchers developed a web-based E-UKGM application designed to assist dental health workers in carrying out UKGM activities. The product design and development process included defining system requirements, designing the application structure and user flow, and developing features that support oral health education activities, target audience data collection, activity logging, monitoring, and reporting of UKGM activities.

The result of the design and development phase is a prototype of the web-based E-UKGM application, designed in accordance with the identified user needs. This prototype features key functionalities that support the implementation of UKGM activities, including oral health education materials, target audience data collection, volunteer logbooks, activity logging, and UKGM activity reporting.

C. Expert Validation

After the product design phase was completed, an expert validation was conducted as part of the research and development (R&D) process to assess the feasibility of the web-based E-UKGM application before it was tested with users. This validation aims to gather input and suggestions

from experts regarding the content, delivery methods, and the application's alignment with the implementation of the Oral Health Program (UKGM), ensuring that the developed product meets user needs and is suitable for use during the field trial phase.

Validation was conducted by three validators: a media/information technology expert, an oral health expert, and a public health program expert. Based on the assessment results from the three validators, an average feasibility percentage of 93.33% was obtained, falling into the "highly feasible" category. These results indicate that the web-based E-UKGM application meets the criteria for content, media presentation, ease of use, and alignment with the implementation of the UKGM program; therefore, it is deemed suitable for use in the next phase of the research.

Furthermore, to obtain a more detailed picture of the instrument's content validity, an analysis of the validity of each item was conducted using Aiken's V method as follows.

• Validity Test

Tabel 1 Testing the Validity of Each Item Using Aiken's V

Item	Validity Score	Interpretation
Item 1	0,75	High
Item 2	0,75	High
Item 3	0,75	High
Item 4	1,00	Very High
Item 5	1,00	Very High
Item 6	1,00	Very High
Item 7	1,00	Very High
Item 8	0,917	Very High
Item 9	1,00	Very High
Item 10	1,00	Very High
Average Total Score = 0.92		

Table 1 Based on the results of calculations using Aiken's V, the validity values for each item ranged from 0.75 to 1.00, with an average of 0.92, indicating a very high level of content validity. All items obtained an Aiken's V value of ≥ 0.75 ; therefore, all items were deemed valid and suitable for use in the product evaluation process.

In addition, the analysis using the Intraclass Correlation Coefficient (ICC) yielded a value of 0.950 ($p < 0.05$), indicating an excellent level of agreement among validators.

These results show that the assessment instrument has good content validity and reliability, making it suitable for use in the assessment process of the web-based E-UKGM application.

D. Product Result

The purpose of product testing is to determine the level of user acceptance and the feasibility of using the web-based E-UKGM application to support the implementation of Dental and Oral Health (UKGM) activities by dental health workers.

Table 2 Frequency Distribution of Cadres' Performance in Dental Health Education Before and After Using the Web-Based E-UKGM Application

Item	Category	Pre-test		Post-test	
		N	%	N	%
1	Poor Performance	9	30%	0	0%
2	Fair Performance	16	53,3%	5	16,7%
3	Good Performance	5	16,7%	25	83,3%
Total		30	100%	30	100%

Table 2 The results show that before using the web-based E-UKGM application, the majority of health workers—16 people (53.3%)—were rated as “fair” in their performance, whereas after using the application, the

majority—25 people (83.3%)—were rated as “good.” These results indicate an improvement in the health workers’ performance in the area of dental health education following the use of the web-based E-UKGM application.

Table 3 Frequency Distribution of Cadre Performance in Simple Examination Tasks Before and After Using the Web-Based E-UKGM Application

Item	Category	Pre-test		Post-test	
		N	%	N	%
1	Poor Performance	5	16,7%	0	0%
2	Fair Performance	22	73,3%	1	3,3%
3	Good Performance	3	10%	29	96,7%
Total		30	100%	30	100%

Table 3 It was found that before using the web-based E-UKGM application, the majority of cadres—22 people (73.3%)—were rated in the “fair” category, whereas after using the application, the majority of cadres—29 people (96.7%)—were rated in the “good” category. These results

indicate an improvement in the cadres’ performance regarding basic oral health examinations after using the web-based E-UKGM application

Table 4 Frequency Distribution of Cadre Performance in UKGM Activity Reporting Before and After the Use of the Web-Based E-UKGM Application

Item	Category	Pre-test		Post-test	
		N	%	N	%
1	Poor Performance	5	16,7%	0	0%
2	Fair Performance	22	73,3%	1	3,3%
3	Good Performance	3	10%	29	96,7%
Total		30	100%	30	100%

Table 4 The results show that before the use of the web-based E-UKGM Application, the majority of cadres—22 people (73.3%)—were rated in the “fair” category, whereas after using the application, the majority of cadres—29 people

(96.7%)—were rated in the “good” category. These results indicate an improvement in the cadres’ performance regarding UKGM activity reporting after using the web-based E-UKGM Application.

Table 5 Results of the Wilcoxon Signed-Rank Test on the Effect of the E-UKGM Application on Volunteer Performance

Item	Performance	P-Value	Interpretation
1	Dental Health Education	0,000	There is a significant difference between the pre-test and the post-test
2	Simple Examinations	0,000	There is a significant difference between the pre-test and the post-test
3	Activity Reporting	0,000	There is a significant difference between the pre-test and the post-test
<i>Wilcoxon Signed Rank Test*</i>			

Table 5 Based on the results of the Wilcoxon Signed-Rank Test, a p-value of 0.000 was obtained for all performance indicators. Since all p-values were less than 0.05 ($p < 0.05$), there was a significant difference between the pre-test and post-test scores for the indicators of dental health education, basic examinations, and activity reporting. These results indicate that the use of the web-based E-UKGM application is effective in improving the performance of dental health cadres.

IV. DISCUSSION

➤ Information Collection

The information-gathering and user-needs identification phase was conducted to assess the current status of Oral and Dental Health Services (UKGM) and to identify user needs regarding the system to be developed. Data were collected through observations and interviews with the Head of the Padangsari Community Health Center in Semarang City, the dentist in charge of the dental clinic, and dental health cadres

within the Padangsari Community Health Center’s service area [7].

The results of the observations and interviews indicated that the UKGM program had been implemented but was not yet functioning optimally. The involvement of dental health cadres in promotive and preventive activities remained limited. Health education sessions, basic examinations, record-keeping, and reporting are still primarily carried out by healthcare professionals. Furthermore, the recording and reporting of activities are still done manually, so documentation, monitoring, and evaluation have not been conducted effectively. Available educational materials are also limited, making it difficult for health workers to provide oral health education to the community.

These conditions indicate that dental health cadres need supportive tools to help them carry out UKGM more effectively. This need aligns with previous research showing that the use of information technology can enhance the

effectiveness of health programs by facilitating access to information, activity documentation, and digital reporting [5]. This is also consistent with Gibson's theory, which states that performance is influenced by individual, psychological, and organizational factors. In this study, the availability of a digital system is one of the organizational factors that can support volunteers in carrying out their duties [6].

The fact that UKGM implementation is still dominated by health professionals indicates that the volunteers' role as a bridge between health professionals and the community has not yet been optimized. Community health workers do not yet routinely conduct oral health education, still require guidance from healthcare professionals for simple examinations, and are not yet optimal in recording and reporting activities. These conditions highlight the need for a support system that can increase community health workers' engagement and facilitate the execution of their duties in a more streamlined and structured manner [10]. In line with Gibson's theory, organizational support is one of the factors that can enhance performance in task execution [11].

The fact that record-keeping and reporting are still done manually also causes the documentation process to take longer, increases the risk of data loss, and complicates the monitoring process. These conditions highlight the importance of a digital information system that can facilitate more systematic recording, documentation, reporting, and monitoring of activities. This is consistent with the research by Suryo et al., who developed a web-based School Dental Health Effort (SDHE) management model to improve the quality of dental health information systems. The study showed that a web-based system can support the management of dental health information in a more structured manner [12]. The use of digital information systems can also speed up record-keeping and reporting and support continuous program evaluation [13].

Based on the interview results, health workers and dental health cadres need a digital system that can provide educational materials, guidelines for implementing activities, record-keeping, documentation, monitoring, and reporting. The cadres also expressed a willingness to use web-based platforms because they are easily accessible and can be used flexibly during field activities. These needs align with the research by Suryo et al. on the development of a web-based SDHE management model to support the dental health information system in elementary schools [14]. The difference is that the study by Suryo et al. focused on dental health activities in elementary schools, whereas this study focuses on UKGM with dental health cadres as the system users. Based on these findings, a web-based E-UKGM application was developed as a support system to help health workers carry out UKGM activities more easily, effectively, in a structured manner, and with proper documentation.

➤ *Model Design and Development*

Based on the results of the user needs assessment, a web-based E-UKGM application was developed to support the implementation of UKGM activities by dental health cadres. The development was carried out using a user-needs approach, ensuring that the application's features are tailored

to the needs of cadres in the field. The application serves not only as a record-keeping tool but also as an educational resource and a guide for implementing activities.

The application's main features include oral health education, UKGM implementation guidelines, a digital logbook, data recording, and activity reporting. The application also provides 13 learning modules, namely an introduction to UKGM, application usage, fundamentals of oral health, oral health problems, oral health maintenance, simple examinations, the role of workers, record-keeping and reporting, communication and educational techniques, early detection, digital oral health promotion, evaluation and follow-up, as well as oral health posters accompanied by several educational videos. The integration of these features and materials is expected to enhance the volunteers' knowledge, skills, consistency, and autonomy in carrying out UKGM activities. The use of a digital system can also support information access, activity efficiency, documentation, and more systematic health reporting [15,16].

➤ *Feasibility and Validity Analysis*

After the design and development process was completed, expert validation was conducted to assess the product's suitability before it was made available to users. The validation was carried out by media experts, experts in oral and dental health, and public health program experts.

The validation results showed that the web-based E-UKGM application achieved an average suitability percentage of 93.33%, falling into the "highly suitable" category. The results of the content validity analysis using Aiken's V method showed an average value of 0.92, while the results of the inter-validator reliability analysis using the Intraclass Correlation Coefficient (ICC) yielded a value of 0.950, indicating an excellent level of agreement among validators.

These validation results indicate that the application meets the criteria for content, functionality, appearance, and ease of use, making it suitable for use as a tool to support the implementation of UKGM activities.

Subsequently, the product was revised based on feedback from the validators, particularly regarding improvements to the user interface, the presentation of educational materials, and enhancements to the activity recording and reporting features. These revisions aim to improve the product's quality prior to user testing.

➤ *Product Result Test*

A product pilot phase was conducted to determine the effectiveness of the web-based E-UKGM application in improving the performance of dental health cadres in carrying out UKGM activities.

• *Dental Health Education*

The results showed an increase in the health educators' performance scores from 1.87 ± 0.68 to 2.83 ± 0.38 . The Wilcoxon test yielded a p-value of 0.000 ($p < 0.05$), indicating a significant difference between the pre- and post-app usage periods. This improvement indicates that the app helped health volunteers conduct educational activities in a more structured

manner through the support of educational materials and activity tracking.

These findings align with the study by Prasko et al., which showed that the use of audiovisual methods and demonstrations can support improvements in toothbrushing knowledge. Similar findings were also reported by Sariyem et al. through the use of 3D storytelling videos to develop toothbrushing skills among elementary school children in Padang Sari, Banyumanik, Semarang. These results suggest that the use of technology-based media can support the delivery of oral health education more effectively [17,18].

• Simple Examinations

The study results show that the average performance score of health volunteers in the simple examination aspect increased from 1.87 ± 0.73 before using the E-UKGM App to 2.70 ± 0.47 after using the app. Statistical test results show a p-value of 0.000 ($p < 0.05$), indicating a significant difference in the health volunteers' performance before and after using the web-based E-UKGM App.

This improvement indicates that using the app can help health workers conduct simple oral health examinations in a more focused manner. The examination guidelines available in the app provide more systematic steps, making it easier for health workers to understand and follow the examination procedures. Additionally, the documentation feature helps health workers record examination results in a more structured way, allowing activities to be carried out and monitored more effectively.

These findings show that digital media not only serve as a source of information but can also support health workers' practice in carrying out their duties in the field. The integration of guidelines and record-keeping into a single app allows health workers to access information and document examination results simultaneously through a simpler process. Thus, the web-based E-UKGM app can support the improvement of health workers' ability to conduct simple oral health examinations in a more systematic manner.

• Activity Reporting

The average score for activity reporting increased from 1.93 ± 0.52 to 2.97 ± 0.18 . The test results showed a p-value of 0.000 ($p < 0.05$), indicating a significant difference before and after the use of the web-based E-UKGM application. The greatest improvement occurred in the aspect of activity reporting, indicating that the web-based system was able to enhance the effectiveness of recording, documenting, and reporting health cadres' activities in a more structured manner.

Overall, the research results show that the use of the web-based E-UKGM application has a significant effect on improving the performance of dental health cadres in carrying out UKGM activities, as reflected in the aspects of dental health education, simple examinations, and activity reporting. The measurement of cadre performance in this study was based on indicators of UKGM activity implementation as an operational form of the dental health cadre performance variable.

These results are consistent with Gibson's theory, which states that individual performance is influenced by individual factors, psychological factors, and organizational factors. In this study, the use of the web-based E-UKGM application is positioned as a representation of organizational factors that serve as work system and technological support in the performance of cadres' duties. This support can improve work ease, task efficiency, and facilitate the achievement of UKGM program objectives, thereby leading to improved performance among dental health cadres.

V. CONCLUSION

The web-based E-UKGM application was successfully developed to meet the needs of dental health workers in supporting health education activities, simple examinations, and UKGM record-keeping and reporting. The application includes features for oral health education, UKGM guidelines, a digital logbook, and activity recording and reporting. Expert validation results indicate that the application is highly suitable for use, with a suitability percentage of 93.33%, an Aiken's V of 0.92, and an ICC of 0.950. Pilot test results show that the application can be used effectively by health workers. Use of the app also improved the health workers' performance, with "good" ratings in the areas of health education (83.3%), simple examinations (96.7%), and reporting (96.7%). There were significant differences between the health workers' performance before and after using the application in all three aspects ($p < 0.05$). Thus, the web-based E-UKGM application is effective as a supportive tool for improving health workers' performance in carrying out UKGM activities.

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