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Web-Based Oral Health Education Improves Knowledge and Reduces Debris Index in Orthodontic Patients

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Abstract: Orthodontic patients face challenges in maintaining oral hygiene due to orthodontic appliances such as brackets and bands that complicate the cleaning process. A lack of knowledge about oral hygiene maintenance during orthodontic treatment is a major factor contributing to a high debris index and an increased risk of caries. A web-based educational media was developed to enhance knowledge and reduce the debris index among orthodontic patients. To develop an innovative, feasible, and effective web-based educational media to improve knowledge and decrease the debris index in orthodontic patients. This study employed a Research and Development (R&D) approach with a pre-experimental one-group pretest–posttest design. The sample consisted of 25 orthodontic patients selected using total sampling. Each respondent completed a questionnaire and underwent debris index examinations before and after the intervention using the web-based educational media. Data analysis included the Intraclass Correlation Coefficient (ICC) to measure inter-expert reliability, Aiken's V to assess content validity, and the Wilcoxon Signed Rank Test to determine differences before and after the intervention. The expert validation test of the web-based educational media obtained an average score of 91.67% (feasible) with a p-value = 0.00. before the intervention, the mean debris index score was 2.68 (poor) and the mean knowledge score was 75.2 (fair). after the intervention, the debris index score decreased to 0.51 (good) and the knowledge score increased to 94.8 (good). this product was proven to be effective with p = 0.001 for knowledge and p = 0.000 for the debris index. The web-based educational media demonstrated potential feasibility and effectiveness as an educational tool to improve knowledge and reduce the debris index among orthodontic patients.

Keywords: *Web-based Educational Media; Knowledge; Debris Index; Orthodontics; Oral Health.*

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I. INTRODUCTION

Health is a state of physical, mental, spiritual, and social well-being that enables individuals to engage in productive activities and remain free from disease [1]. Efforts to improve the population's overall health status have become a national priority, serving as the foundation for developing a productive and competitive generation [2]. The Government of Indonesia has established an integrated promotive, preventive, and curative approach, as mandated in Law of the Republic of Indonesia No. 17 of 2023 [3]. One of its strategic focuses is the enhancement of oral health, given its inseparable relationship with general health [4].

Oral health plays an essential role in fundamental functions such as speaking, chewing, as well as overall quality of life and self-confidence [5]. However, data from the 2023 Indonesia Health Survey (SKI) indicate that oral health problems remain highly prevalent, reaching 56.9% [6]. In addition to caries and periodontal disease, malocclusion represents a significant concern, with a global prevalence of 56% [7] and an estimated prevalence of 80% in Indonesia [8]. Malocclusion not only affects aesthetics and function but also increases the risk of plaque accumulation, which can lead to dental caries, gingivitis, and periodontal tissue damage [9].

Orthodontic treatment is one of the primary solutions for managing malocclusion; however, this procedure carries risks related to oral hygiene [10]. The use of fixed orthodontic appliances such as brackets and bands can create retentive areas for plaque, requiring patients to have adequate knowledge and skills to maintain proper oral hygiene [11]. A study by Yesena, Q.A., et al. (2021) reported that 20.8% of orthodontic patients experienced difficulties in cleaning fixed orthodontic appliances [12]. One of the main contributing factors to these difficulties is the lack of patient knowledge regarding proper techniques and the use of adjunctive cleaning aids during orthodontic treatment [13]. This condition leads to

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an increased prevalence of dental caries, gingivitis, and other periodontal problems throughout the treatment period [14].

Adequate knowledge regarding proper cleaning techniques, the use of auxiliary tools, and the risks associated with poor oral hygiene is essential to support the success of orthodontic treatment [15]. Health promotion through educational media serves as an effective strategy to enhance patient knowledge and influence positive health behavior change [16]. With the advancement of digital technology, electronic-based educational media including websites have become increasingly preferred due to their interactive nature, ease of access, and ability to deliver information more attractively compared to conventional media [17].

Web-based educational media offer advantages in delivering information through text, images, videos, and infographics, thereby enhancing understanding and information retention [18]. This type of media has the potential to improve orthodontic patients' knowledge regarding oral hygiene care while simultaneously encouraging positive behavioral changes. In addition to providing educational materials, the development of supplementary features such as appointment reminders and debris index monitoring can help increase patient compliance with scheduled visits and assist oral health professionals in evaluating the patient's oral hygiene status more effectively.

Based on these needs, this study developed a web-based oral health educational media specifically designed for orthodontic appliance users at Nadira Tusam Dental Clinic. This media is expected to enhance patients' knowledge, awareness, and behaviors in maintaining oral hygiene throughout orthodontic treatment, as well as contribute to the overall improvement of their oral health status.

II. METHODS

This study employed a Research and Development (R&D) design with a Mixed Methods approach, consisting of five main stages: (1) initial information gathering, (2) design and development of the media model, (3) expert validation, (4) model testing through a quasi-experimental design, and (5) analysis of results followed by final revisions.

The research was conducted at the Nadira Tusam Dental Clinic in Semarang City from May to July 2025. The study population comprised orthodontic patients who routinely attended control visits. A purposive sampling technique was applied, involving 25 patients, and data collection was carried out using a pre-test and post-test design.

The determination of the sample size was based on specific inclusion and exclusion criteria. The inclusion criteria were: (1) patients who were willing to participate as respondents, (2) patients undergoing orthodontic treatment at the Nadira Tusam Dental Clinic, and (3) orthodontic patients capable of using a mobile phone. The exclusion criterion was patients who were unable to attend control visits within a one-month period as scheduled by the orthodontic specialist.

This study received ethical approval with the certificate number 637/EA/F.XXIII.38/2025.

III. RESULTS AND DISCUSSION

Information gathering in this study was carried out through interviews with an orthodontic specialist and a dental therapist. The interview results revealed that many orthodontic patients were still inconsistent in attending their scheduled follow-up visits, and their oral hygiene remained suboptimal despite brushing their teeth regularly. These findings indicate a gap in the educational process provided during orthodontic treatment. The education delivered at the clinic is still predominantly one-way, limited to verbal explanations during appointments, and has not offered continuous reinforcement of knowledge and oral hygiene practices at home. Furthermore, patients often lack understanding of proper cleaning techniques and the use of auxiliary tools such as interdental brushes, dental floss, and mouthwash.

Based on the information collected, no educational media was found that integrates visual-interactive features, step-by-step guidance, and monitoring support specifically designed for orthodontic patients. Existing educational approaches have not been able to help patients form consistent oral hygiene habits due to limited access to ongoing information, absence of reminders, and lack of engaging visual materials. This condition highlights the need for an innovative educational media that not only delivers information but also encourages behavioral change through an interactive, accessible, and patient-centered digital approach.

Therefore, a web-based educational media was developed to provide interactive, easily accessible learning resources equipped with visual materials, instructional videos, and supportive features aimed at improving patients' knowledge and motivation in maintaining oral hygiene during orthodontic treatment. This media is expected not only to enhance patient understanding but also to contribute to reducing the Debris Index among orthodontic patients at Nadira Tusam Dental Clinic.

The web-based educational media consists of two main interfaces: an admin interface and a patient interface. The admin interface includes features for managing the number of patients, doctor schedules, appointments, and examination results. Administrators can also add and manage educational content and dental health articles, ensuring that patients receive relevant and beneficial information. Meanwhile, the patient interface is designed to provide a user-friendly and informative experience. It includes a profile page for updating personal information, an appointment menu for viewing appointment history and examination results, and access to an education menu containing dental health articles. Patients can also view the list of practicing doctors through the doctor page. In addition, pre-test and post-test features are provided to measure patients' knowledge before and after accessing the educational materials.

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The design of this educational media was developed using a Research and Development (R&D) approach. The validation process involved three experts: an orthodontic specialist, a dental therapist, and an information technology expert. These experts assessed the feasibility, content suitability, visual presentation, and usability of the web-based educational media. The validation results showed that the media obtained a score of 91.67%, indicating that it is feasible to be used as an educational tool for orthodontic patients.

Overall, the web-based educational media was designed not only as an information delivery tool but also as a learning platform that supports the formation of better oral hygiene habits. Through its visual-interactive approach and high accessibility, this media is expected to positively impact patients' knowledge, motivation, and behavior. The design of the web-based educational media is presented in the following section.

Fig 1. Web-Based Educational Media Interface for Patients

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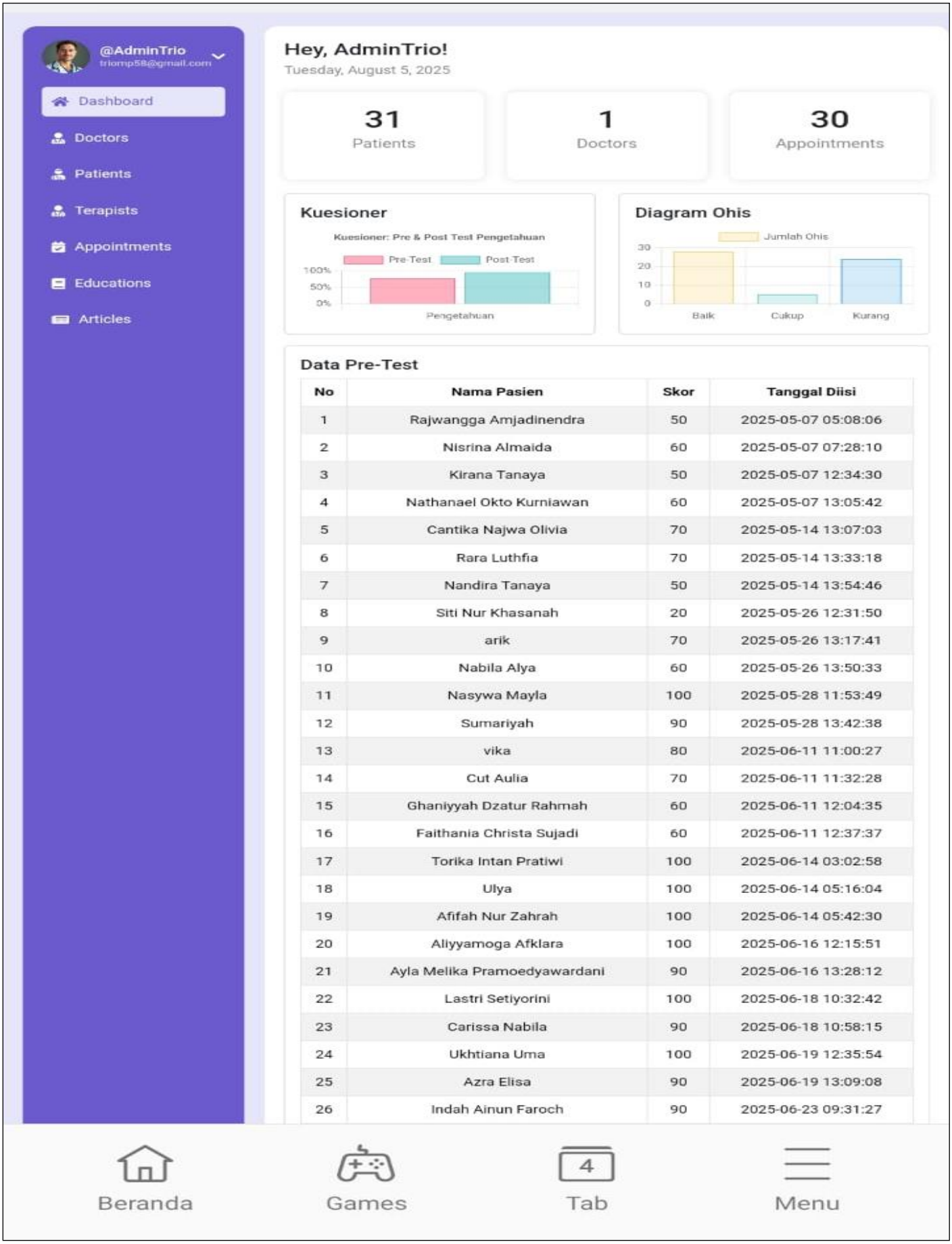

Fig 2. Web-Based Educational Media

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A. Interface for Administrators

Upon completing the development process and presenting the features of the web-based educational media for both patient and administrator interfaces, the subsequent phase focused on assessing the effectiveness of the developed platform in enhancing patients' knowledge and oral hygiene status. This assessment was carried out by analyzing differences in knowledge scores obtained prior to and after exposure to the educational content (pre-test and post-test), alongside measurements of changes in the Debris Index following the implementation of the media. The evaluation of these parameters provides an evidence-based understanding of the extent to which the web-based educational media contributes to improving patient comprehension and promoting better oral hygiene practices throughout orthodontic treatment.

➢ *Patient Knowledge Assessment in the Pre-test and Post-test*

Table 1. Pre-test and Post-test Knowledge Assessment Data

No.	Characteristics	Good		moderate		Poor	
		n	%	n	%	n	%
1.	Patient Knowledge Pre test	12	48%	9	36%	4	16%
2.	Patient Knowledge Post test	25	100%	0	0	0	0

Table 1 shows that patients' knowledge during the pre-test was categorized as good at 48% (12 patients), moderate at 36% (9 patients), and poor at 16% (4 patients). In contrast, during the post-test, all patients achieved a good level of knowledge, reaching 100% (25 patients).

➢ *Pre-test and Post-test Debris Index Assessment Data*

Table 2. Pre-test and Post-test Debris Index Assessment Data

No.	Characteristics	Good		moderate		Poor	
		N	%	n	%	n	%
1.	Debris Index Assessment Pre test	0	0	2	8%	23	92%
2.	Debris Index Assessment Post test	24	96%	1	4%	0	0

Table 2 shows that the patients' debris index scores during the pre-test were categorized as moderate in 8% (2 patients) and poor in 92% (23 patients). In contrast, the post-test results demonstrated a substantial improvement, with 96% (24 patients) classified in the good category and 4% (1 patient) in the moderate category.

➢ *Effectiveness of the Web-Based Educational Media on Orthodontic Patients' Knowledge*

Table 3. Effectiveness of the Web-Based Educational Media on Orthodontic

Varibel	Statistik
Orthodontic Patients' Knowledge	
Z	-3.314
Asymp.Sig.(2-tailed)	0.001

*Wilcoxon

Table 3 shows the results of the effectiveness test of the web-based educational media on orthodontic patients' knowledge. The p-value obtained was 0.001 (< 0.05), indicating that the developed web-based educational media was effective in increasing patients' knowledge. Furthermore, the Z value of –3.314 demonstrates that the distribution of pre-test scores was significantly lower compared to the post-test scores, confirming a substantial improvement after the intervention.

Knowledge is a crucial factor in influencing behavioral change, including patient compliance in maintaining oral health. Adequate knowledge increases orthodontic patients' motivation to maintain their oral hygiene and contributes to an improved quality of life [19]. Knowledge also plays a role in shaping personal awareness, enabling individuals to apply the information they acquire; therefore, individuals with good knowledge tend to have a higher level of awareness regarding health maintenance [20]. Educational media likewise plays an essential role in improving individual knowledge and enhancing awareness of oral hygiene [21].

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The web-based educational media developed in this study contains various educational materials related to oral hygiene during orthodontic treatment. These materials include proper tooth-brushing techniques for fixed orthodontic appliance users, the use of additional cleaning aids such as interdental brushes and mouthwash, and information regarding recommended dietary patterns and foods that should be avoided during treatment. In addition, the media provides education about the importance of regular dental visits and guidance on managing minor discomfort that may occur while wearing orthodontic appliances. The educational content is presented in different formats including text, images, and interactive videos making the media more engaging and easier for patients to understand.

The inclusion of pre-test and post-test features also allows patients to evaluate their improvement after accessing the materials. Web-based educational media has clear advantages, as it is able to provide accurate, easy-to-understand information tailored to patient needs [22]. The use of multimodal content such as text, images, and interactive videos enhances learning experiences and facilitates better information retention [23]. These findings are consistent with the study by Fornaini and Rocca (2022), which reported that digital educational media can significantly increase oral health knowledge due to its interactive nature and accessibility at any time [24]. Another study by Kuwabara et al. (2019) further emphasized that growing scientific evidence supports the use of digital health technologies as tools to improve patient education and promote better skill application and behavioral change [25].

Thus, the development of this web-based educational media for orthodontic patients not only improves their knowledge of oral hygiene but also has the potential to enhance compliance, particularly with regard to maintaining routine dental check-ups throughout orthodontic treatment.

- *Effectiveness of Web-Based Educational Media on the Debris Index of Orthodontic Patients*

Table 4 presents the results of the effectiveness test of the web-based educational media on the debris index of orthodontic patients. The p-value was <0.05, specifically 0.000, indicating that the development of the web-based educational media was effective in improving the oral hygiene of orthodontic patients. Furthermore, the Z-value of 4.772 demonstrates that the distribution of pre-test scores was significantly lower compared to the post-test scores, confirming a substantial improvement in patients' oral cleanliness after using the media.

Table 4 Effectiveness of Web-Based Educational Media on the Debris Index of Orthodontic Patients

Varibel	**Statistik**
Debris Index of Orthodontic Patients	
Z	-4.772
Asymp.Sig.(2-tailed)	0.000

The reduction in debris index scores reflects an improvement in oral hygiene, which is closely associated with increased knowledge [26] and behavioral changes among orthodontic patients in maintaining oral health [22]. Continuous education provided through web-based media helps patients understand the importance of oral hygiene and the correct tooth-brushing techniques. Consequently, patients are more motivated and consistent in implementing habits that promote oral cleanliness. This finding aligns with the study by Hasrini et al. (2022), which reported that technology-based dental health education interventions can improve oral health and hygiene [26]. Similarly, research by Alkadhi et al. (2017) emphasized that the use of interactive digital media can significantly enhance oral hygiene in orthodontic patients, as information is delivered in a manner that is easier to understand and accessible at any time [27]. Therefore, the implementation of web-based educational media not only impacts knowledge improvement but also contributes substantially to behavioral changes, resulting in better clinical outcomes, particularly in reducing debris index scores among orthodontic patients [28].

IV. CONCLUSION

The development of web-based educational media is deemed feasible and effective, significantly influencing both the increase in knowledge and the reduction of debris index scores in orthodontic patients.

- Based on the information collected, the web-based educational media was considered feasible for use by orthodontic patients. This was confirmed through a feasibility assessment conducted with three validators, yielding a score of 91.67%, which is categorized as suitable.
- The use of web-based educational media demonstrated potential feasibility and effectiveness in enhancing the knowledge of orthodontic patients. This was statistically supported by a significant p-value of 0.001.
- The implementation of web-based educational media also had a significant impact on reducing the debris index scores of orthodontic patients, as evidenced by a p-value of 0.000.

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