

The Development of an Oral Hygiene Kit for Preschool Children: Integrating Play-Based Learning and Visual Communication

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ABSTRACT

Oral-health education during early childhood is important for developing preventive hygiene habits and positive attitudes towards dental care. This study developed an Oral Hygiene Kit as a printed, play-based educational tool for preschool children aged four to six years. Using an Action Research approach, the study involved four stages: (i) issue identification, (ii) design and ideation, (iii) implementation, and (iv) evaluation and refinement. The final kit consisted of a board game, flash cards, and a Rubik's Cube, packaged within a child-friendly visual design. The Rabbit Dentist character was used as the central visual identity to create familiarity, encourage engagement, and reduce children's unfamiliarity with dental-care concepts. The materials were implemented in a dental-clinic setting, where children interacted with the tools while waiting for consultation or treatment. Findings indicate that interactive printed materials can support oral-health communication by combining visual, tactile, and play-based learning experiences. The study highlights the potential of printed educational tools and packaging design as effective media for promoting early oral-health awareness in informal healthcare environments.

Keywords: Oral Health Education; Preschool Children; Play-Based Learning; Visual Communication; Educational Packaging;

INTRODUCTION

Oral health is an essential component of children's overall health and well-being. During early childhood, oral health conditions such as dental caries, gum problems, and poor oral hygiene may negatively affect children's physical development, nutrition, speech, self-confidence, and quality of life. Despite ongoing public health initiatives, oral diseases remain among the most prevalent health conditions affecting children worldwide. Consequently, promoting oral health awareness and preventive behaviors from an early age has become an important priority in both healthcare and education (Bramantoro et al., 2021).

The preschool years represent a critical period for the development of lifelong health habits. Children aged four to six years are highly receptive to new knowledge and behavioural guidance, making this stage particularly suitable for introducing oral-hygiene practices such as toothbrushing, healthy dietary choices, and regular dental visits. Research indicates that early oral-health education can positively influence children's knowledge, attitudes, and behaviours, thereby supporting the development of long-term preventive health practices (Das et al., 2025). Therefore, educational interventions targeting preschool children have significant potential to contribute to improved oral-health outcomes.

Although oral-health education is widely implemented through schools, healthcare settings, and community programmes, many educational approaches continue to rely on verbal instruction, demonstrations, printed

leaflets, or informational posters. While these methods provide important information, they may not always align with the learning preferences and developmental needs of young children. Preschool learners generally respond more positively to visual, interactive, and play-based experiences that encourage exploration, participation, and repeated engagement (Wallace & Hesterman, 2021). This highlights the need for educational materials that present oral-health concepts in a manner that is both meaningful and enjoyable for young learners.

Play-based learning and visual communication have gained increasing recognition as effective approaches for supporting children's learning and engagement. Through storytelling, games, illustrations, and hands-on activities, complex information can be translated into child-friendly experiences that encourage active participation. Studies have highlighted that game-based dental health education increases dental knowledge and tooth brushing skills and is more effective than didactic information alone for promoting childhood dental health (Makuch & Reschke, 2001), Akkaya & Sezici, 2021). Visual communication strategies, including character design, colour application, and interactive printed materials, can further enhance children's attention, motivation, and information retention. These approaches are particularly relevant in health education, where sustained engagement is often necessary to support behavioural change and habit formation.

Despite growing interest in child-centred educational approaches, there remains a limited number of integrated printed learning tools specifically developed for preschool oral-health education within dental-clinic environments. Existing materials often focus on information delivery rather than interactive engagement and may not fully utilise the educational potential of visual communication and packaging design. Therefore, this study developed an Oral Hygiene Kit consisting of a board game, flash cards, and a Rubrik's Cube to promote oral-health awareness among preschool children. By integrating play-based learning, visual communication, and educational packaging design, the study seeks to demonstrate how printed educational materials can contribute to oral-health promotion in a manner that is engaging, accessible, and developmentally appropriate for young learners.

Problem Statement

Oral health is an important component of children's overall well-being, as poor oral hygiene during early childhood may contribute to dental caries, pain, discomfort, eating difficulties, and negative attitudes towards dental care. Preschool children are at a crucial developmental stage where health-related habits begin to form; however, many children within this age group have limited understanding of proper toothbrushing, healthy food choices, and the importance of regular dental visits. Recent evidence shows that oral-health promotion programmes involving children, teachers, and parents can produce positive outcomes in oral-health knowledge, behaviour, and attitudes (Bramantoro et al., 2021). This highlights the need for oral-health education to be introduced early through approaches that are suitable for young learners.

Although oral-health education is commonly delivered through verbal explanation, posters, or demonstrations, such approaches may not fully engage preschool children due to their short attention span and developmental learning needs. Children aged four to six years respond more effectively to visual, tactile, and play-based learning experiences that allow them to explore, repeat, and interact with information. Therefore, oral-health education materials should not only provide accurate information but also present the content through attractive visuals, simple language, storytelling, and interactive activities. Play-based and child-centred learning approaches are particularly relevant because they support engagement, participation, and meaningful learning among young children (Wallace & Hesterman, 2021).

In addition, dental clinics are often viewed primarily as treatment spaces, while their potential as informal learning environments remains underutilised. Children waiting for dental consultation or treatment can benefit from educational materials that familiarise them with oral-care concepts and create positive associations with dental visits. This is important because dental fear and anxiety remain common concerns in paediatric dentistry, and recent studies suggest that child-centred, non-pharmacological interventions can help reduce anxiety and improve children's dental-care experiences (Cunningham et al., 2021; Kong et al., 2024). However, there remains a lack of integrated printed learning tools specifically designed for preschool oral-health education within dental-clinic settings.

Therefore, this study addresses the need to develop a child-centred Oral Hygiene Kit that combines printed learning materials, play-based activities, and visual communication design. The kit aims to support preschool children's oral-health awareness through engaging components such as a board game, flash cards, and a Rubik's Cube, while also demonstrating the potential of packaging design as an educational communication tool. Packaging design is relevant in this study because visual features such as colour, layout, shape, and graphic elements can communicate meaning and influence user engagement (Spence & Van Doorn, 2022).

Aims

This study aims to develop child-centred printed learning materials in supporting oral-health education among preschool children that integrate visual communication, printed learning tools, and educational packaging in promoting oral-health awareness within a dental-clinic setting.

METHODOLOGY

This study adopted an Action Research approach to facilitate the systematic development and improvement of printed oral-health educational materials for preschool children. Action Research is characterised by an iterative cycle of planning, action, observation, and reflection, enabling researchers to address practical problems while continuously improving the intervention through stakeholder feedback (Casey et al., 2026; Van der Vlegel-Brouwer et al., 2023). In this study, the Action Research process was operationalised through four stages: (i) Issue Identification, (ii) Design and Ideation, (iii) Implementation, and (iv) Evaluation and Refinement. The cyclical nature of the approach allowed continuous improvement of the learning materials based on observations, expert feedback, and user engagement throughout the project. The research approach involves four main stages as below:

Issue Identification

The initial phase involved identifying core challenges in preschool oral health education. Informal observations, discussions and interviews with early childhood educators and dental practitioners at the participating dental clinic; highlighted a lack of engaging, developmentally appropriate resources to teach oral hygiene effectively.

The issue identification stage focused on three key concerns related to oral-health education among preschool children: limited oral-health literacy, lack of engaging and developmentally appropriate printed learning materials, and the underutilisation of dental clinics as informal learning environments.

First, limited oral-health literacy among preschool children was identified as a major concern. Oral-health literacy is important because it influences how children understand, practise, and maintain basic hygiene behaviours such as toothbrushing, food selection, and routine dental care. Recent studies show that early oral-health knowledge and behaviour are closely connected to children's oral-health outcomes, particularly among preschool-aged children whose habits are still developing (Bramantoro et al., 2021; Wu et al., 2024). Therefore, introducing oral-health concepts at an early stage is necessary to support preventive behaviour and reduce the risk of dental problems during childhood.

Second, the study identified a lack of engaging and developmentally appropriate printed learning materials for preschool oral-health education. Children aged four to six require learning experiences that are visual, interactive, simple, and enjoyable. Conventional oral-health education, which often relies on verbal explanation or static posters, may not fully support children's attention span or developmental needs. Current early-childhood research emphasises that play-based and experiential learning can support children's understanding by allowing them to explore concepts through active participation, imagination, and hands-on engagement (Prins et al., 2022). This highlights the need for printed learning tools such as storybooks, Rubik's Cube, flashcards, and activity-based materials that can translate dental-health information into child-friendly learning experiences.

Third, dental clinics were identified as an underutilised setting for informal oral-health education. Although clinics are commonly associated with treatment, they also provide opportunities to expose children to positive oral-health messages while they wait for consultation or treatment. This is important because dental anxiety remains a common issue among children and may affect their willingness to engage with dental care. Recent studies suggest that non-pharmacological and child-centred approaches can help reduce dental fear and improve children's experience in dental settings (Kong et al., 2024; Cunningham et al., 2021). Therefore, placing printed oral-health learning tools in clinic waiting areas can support both education and emotional familiarisation, making dental care appear less intimidating and more approachable for young children.

Design and Ideation

The design and ideation stage was carried out based on the issues identified during the initial phase of the study. The development of the printed learning materials was guided by the need to improve preschool children's oral-health literacy through engaging, developmentally appropriate, and clinic-friendly educational tools. Ideas were generated through concept development discussions involving the researchers, design experts, and dental practitioners from the participating dental clinic.

During this stage, dental practitioners provided input on the accuracy and relevance of the oral-health content, including toothbrushing practices, healthy food choices, tooth recognition, and basic dental-care routines. This ensured that the educational messages embedded in the materials were clinically appropriate and suitable for young children. At the same time, design considerations such as illustration style, typography, colour selection, layout arrangement, and material format were explored to ensure that the tools were visually appealing and accessible to preschool learners.

The ideation process emphasised child-centred and play-based learning principles. Since children aged four to six years respond strongly to visual, tactile, and story-based learning experiences, the materials were designed using simple language, colourful illustrations, friendly characters, and interactive activities. The Rabbit Dentist character was developed as a visual guide to create familiarity, reduce fear, and encourage positive emotional association with dental care.

Several printed learning tools were proposed and developed: a board game, magnetic activity book, flash cards, and a Rubik's Cube. Each material served a specific educational function. The magnetic activity book encouraged hands-on participation; Rubik's Cube supported recognition and memory; the board game promoted active learning through play; and flashcards reinforced key oral-health messages in a simple and repetitive format. Through this process, the design outcomes were aligned with both educational objectives and oral-health promotion goals.

Implementation

The implementation stage involved the introduction of the prototype printed learning materials in the participating dental clinic. The materials were placed at the registration and waiting area of the participating dental clinic, where preschool children aged four to six years were able to interact with the tools while waiting for their dental consultation or treatment. This setting was selected because it provided a natural environment for informal oral-health learning and allowed children to engage with the materials in a real dental-care context.

During the implementation process, children explored the printed learning tools with the presence of their parents or guardians. The materials introduced included the magnetic activity book, Rubik's Cube, board game, and flashcards. Each material was designed to communicate basic oral-health concepts such as toothbrushing, tooth recognition, healthy food choices, dental-care routines, and positive attitudes towards dental visits. The use of multiple printed formats enabled children to experience oral-health education through visual, tactile, and play-based activities.

The researchers and dental practitioners observed the children's interaction with the materials throughout the session. Particular attention was given to children's level of engagement, ability to understand the visual

messages, response to the characters and illustrations, participation in the activities, and willingness to continue exploring the materials. Parents or guardians were also informally consulted to obtain feedback on the children's interest, comprehension, and suitability of the materials for home or clinic-based learning.

This implementation stage provided practical insights into how preschool children responded to the printed learning tools in an actual dental-clinic environment. The observations and feedback collected during this stage served as the basis for the subsequent evaluation and refinement process, ensuring that the final materials were not only visually appealing but also educationally meaningful, age-appropriate, and suitable for use in oral-health promotion.

Evaluation and Refinement

The evaluation and refinement stage was conducted after the prototype printed learning materials were implemented in the participating dental clinic. This stage aimed to assess the educational suitability, usability, visual effectiveness, and engagement value of the materials among preschool children aged four to six years. The evaluation was guided by feedback from multiple stakeholders, including dental practitioners, parents or guardians, and observations of children's interactions with the materials. Overall, 30 parents and guardians and three dental practitioners were involved in the session.

Data were collected through direct observation, informal feedback from parents or guardians, and discussions with dental practitioners. The observation focused on children's attention span, level of participation, ability to understand the visual messages, preference for specific learning tools, and response towards the character, illustrations, and interactive activities. Feedback from parents or guardians was used to understand whether the materials were suitable, enjoyable, and easy for children to use. Dental practitioners reviewed the accuracy of the oral-health messages and assessed whether the content was appropriate for communication within a dental-clinic setting.

The evaluation findings indicated that children responded positively to materials that included visual storytelling, tactile interaction, and game-based activities. Tools such as Rubik's Cube, flashcards, and magnetic activities encouraged active participation and sustained children's interest during the waiting period. However, several areas for improvement were also identified. These included the need to simplify certain instructions, improve visual hierarchy, increase the clarity of selected illustrations, and ensure that the oral-health messages were presented in short, child-friendly statements.

Based on the findings, the printed learning materials were refined to improve their clarity, usability, and developmental suitability. The refinement process involved revising instructional text, adjusting layout composition, enhancing colour contrast, improving the consistency of the Rabbit Dentist character, and reorganising selected activity elements to support easier interaction. These refinements strengthened the overall educational value of the materials and ensured that the final outputs were visually engaging, clinically accurate, and appropriate for preschool oral-health education in a dental-clinic environment.

RESULTS AND DISCUSSION

Development of the Oral Hygiene Kit

The primary outcome of this project was the development of an Oral Hygiene Kit designed to promote oral-health awareness among preschool children aged four to six years. The kit was developed based on the issues identified during the preliminary stage, particularly limited oral-health literacy among young children, the lack of engaging educational materials, and the need for child-friendly learning experiences within dental-clinic environments. The final product integrated three educational components, namely a board game, flash cards, and a Rubik's Cube.

Each component was designed to support different aspects of oral-health learning. The board game encouraged active participation through play-based learning activities that enjoyably introduced oral-hygiene concepts. The flash cards were developed to reinforce key messages through visual repetition and simple explanations,

while the Rubik's Cube provided hands-on interaction that encouraged children to recognise oral-health concepts through problem-solving activities. This is consistent with recent studies which highlight that oral-health promotion programmes involving children can improve oral-health knowledge, behaviour, and attitudes when delivered through engaging educational approaches (Bramantoro et al., 2021).

The development of the Oral Hygiene Kit demonstrates how printed educational materials can be transformed into an interactive learning system rather than functioning as standalone informational resources. By combining educational content with play-based activities, the kit provides opportunities for repeated engagement, which is particularly important in early childhood education where learning is enhanced through exploration, repetition, and active participation.

Child-Centred Visual Communication and Character Design

A significant outcome of the project was the application of child-centred visual communication principles throughout the design process. The final design adopted bright colours, playful illustrations, simplified visual structures, and age-appropriate typography to ensure that the educational content was accessible and engaging for preschool children. These design decisions were informed by the developmental characteristics of children aged four to six years, who generally respond positively to visual stimuli, storytelling, and interactive learning experiences.

Central to the visual identity of the Oral Hygiene Kit was the development of the Rabbit Dentist character. The character was consistently applied across the packaging and educational materials to create familiarity and establish a positive emotional connection with oral-health learning. The Rabbit Dentist functions as both a visual guide and an educational ambassador, helping to communicate oral-health messages in a friendly and non-threatening manner. The use of character-based and playful visual strategies is appropriate for young children because play-based learning supports children's engagement, development, and meaningful participation in learning activities (Wallace & Hesterman, 2021).

The findings suggest that visual communication plays a crucial role in translating professional oral-health knowledge into forms that are understandable and appealing to young learners. Rather than presenting oral-health information through clinical or text-heavy approaches, the project demonstrates the effectiveness of integrating educational content with character-based storytelling and playful visual design. This approach supports children's engagement while maintaining the educational integrity of the oral-health messages.

Packaging as an Educational Communication Tool

Another important finding of the study is the role of packaging as an educational communication medium. Traditionally, packaging functions primarily as a protective container for products. However, the final design of the Oral Hygiene Kit demonstrates that packaging can also contribute to learning and communication objectives. The packaging was designed not only to contain the educational materials but also to introduce oral-health concepts through visual storytelling, instructional graphics, and character-based communication.

The exterior surfaces of the package feature the Rabbit Dentist character, oral-health visuals, and educational messages that encourage children to engage with the contents of the kit. This transforms the packaging into an extension of the learning experience by creating curiosity and providing opportunities for informal learning before the educational activities begin. This finding is supported by Spence and Van Doorn (2022), who explain that packaging design communicates meaning through visual features such as colour, shape, layout, and graphic elements.

From a visual communication perspective, the packaging serves as a bridge between oral-health education and user engagement. The use of bright colours, child-friendly illustrations, and interactive visual elements helps create a positive first impression while supporting the overall educational objectives of the project. This finding highlights the potential of packaging design to contribute to health-promotion initiatives, particularly in early childhood education where visual engagement is essential for effective communication.

Overall, the findings demonstrate that the integration of educational content, play-based learning activities, character design, and packaging communication can create a holistic learning experience that supports oral-health awareness among preschool children. The Oral Hygiene Kit provides an example of how printed educational materials can be innovatively designed to enhance health communication while remaining engaging, accessible, and developmentally appropriate for young learners.

Implications and Significance of the Study

The study demonstrates the potential of integrating printed educational materials, visual communication strategies, and play-based learning approaches to support oral-health education among preschool children. The findings contribute to educational practice, healthcare communication, and the creative design industry by highlighting how age-appropriate learning materials can be used to promote preventive health behaviours from an early age.

From an educational perspective, the Oral Hygiene Kit provides an alternative approach to early childhood health education through interactive and child-centred learning experiences. The integration of a board game, flash cards, and Rubik's Cube enables children to learn through exploration, repetition, and active participation. This supports existing research that emphasises the importance of play-based learning in enhancing children's engagement, motivation, and knowledge retention (Wallace & Hesterman, 2021). The study therefore demonstrates how printed educational resources can be designed to accommodate the developmental needs of preschool learners while supporting meaningful learning outcomes.

From a healthcare perspective, the study highlights the potential role of educational materials in promoting preventive oral-health practices. The collaboration between researchers and dental practitioners ensured that the content reflected accurate oral-health information while remaining accessible to young children. The findings suggest that dental clinics can function not only as treatment centres but also as informal learning environments where children are exposed to positive oral-health messages. Such initiatives may contribute to improved oral-health awareness and encourage the development of healthy habits from an early age.

From a design and industry perspective, the study demonstrates the value of visual communication and packaging design in health-promotion initiatives. The development of the Rabbit Dentist character and the use of child-friendly packaging transformed the educational materials into a cohesive learning experience. The findings illustrate how packaging can extend beyond its traditional protective function to become a communication medium that supports educational objectives. This contributes to the growing recognition of design as a strategic tool for health communication and provides opportunities for innovation within the printing, packaging, and educational publishing sectors.

The study also supports several Sustainable Development Goals (SDGs), particularly SDG 3 (Good Health and Well-being) through the promotion of preventive oral-health practices, and SDG 4 (Quality Education) through the development of accessible and engaging learning materials for young children. By integrating health education with visual communication and interactive design, the project demonstrates a practical and sustainable approach to supporting children's well-being and lifelong learning.

CONCLUSION

This study developed an Oral Hygiene Kit as a printed, play-based educational tool to promote oral-health awareness among preschool children aged four to six years. Through an Action Research approach, the project identified key issues in preschool oral-health education, designed appropriate printed learning materials, implemented the prototype in a dental-clinic setting, and refined the final product based on observation and stakeholder feedback.

The final kit, consisting of a board game, flash cards, and a Rubik's Cube, demonstrates how printed educational materials can be transformed into an interactive and child-centred learning experience. The use of the Rabbit Dentist character, colourful visual design, and playful packaging helped translate oral-health information into a format suitable for young learners. The study also highlights the potential of dental clinics

as informal learning environments where children can engage with positive oral-health messages while waiting for treatment.

Overall, the project contributes to early childhood health education by integrating oral-health promotion, visual communication, packaging design, and play-based learning. The findings suggest that well-designed printed learning tools can support children's engagement, reduce unfamiliarity with dental-care concepts, and encourage early preventive oral-health habits. Future studies may expand the implementation to preschools, community health programmes, and larger groups of children to evaluate the long-term effectiveness of the kit in improving oral-health knowledge and behaviour.

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