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Expert Review of the IA Toothbrushing Skill Learning Model 3D Printing-Based for Early Childhood

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Abstract: The problem of high rates of dental decay in early childhood can be addressed through learning. The IA tooth brushing skills learning model was developed to improve independent tooth brushing skills in children aged 5-6 years. An evaluation needs to be conducted to ensure that the developed learning model is feasible for use. The aim of the research is to evaluate the feasibility of the IA-tooth brushing skills-based 3D printing learning model for early childhood. The evaluation method is through expert review with experts who have a minimum of 15 years of work experience in their field, consisting of early childhood education material experts, learning design, and learning media. The research instrument uses interview guidelines and open-ended questionnaires that have previously been validated by expert. The findings from the expert review were collected and followed up with improvements based on the feedback. The IA tooth brushing skills learning model has been modified according to feedback from the expert review. Conclusion, the feasibility evaluation through expert review successfully improved the IA tooth brushing skills learning model based on 3D printing, making it highly feasible for teaching 5–6-year-old children to brush their teeth independently.

Keywords: Expert Review, IA Toothbrushing, Early Childhood

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A. INTRODUCTION

The early childhood development period needs serious attention from parents, teachers, and the government so that children can grow and develop optimally, because the golden age of early childhood is limited. The high rate of dental damage in 5-year-old children, based on data from the Indonesian Health Survey 2023, with a dmf-t index of 6.7, means that every 5-year-old child in Indonesia suffers from 5–6 damaged teeth rusak (Kementerian Kesehatan, 2023). We must address this issue immediately to prevent damage to the permanent teeth that have already begun to grow. During preschool education, we need to equip children with the ability to clean their teeth independently through toothbrushing education. The provision of these skills can be carried out in school by developing a "toothbrushing skills" learning model using appropriate strategies and teaching materials so that the learning objectives can be achieved.

Learning the skill of tooth brushing is a domain of psychomotor learning, aimed at training the fine motor skills of children, particularly the fingers. Therefore, the learning process requires strategies that can train the procedures and stages of tooth brushing, as well

as appropriate teaching materials to achieve the goal of enabling 5–6-year-old children to brush their teeth independently. Early childhood children have specific characteristics. Therefore, teaching materials should be tailored to these characteristics and their learning context to engage and motivate students as they learn the knowledge, stages, and techniques of tooth brushing.

The IA toothbrushing skill learning model 3D printing-based for early childhood was created by following a specific process that combines Borg and Gall's methods at the beginning of the research and then uses the System Approach of Educational Research and Development from Dick and Carey. The developed learning model needs to be evaluated before being used in actual teaching. One of the evaluation stages is the expert review, which is a preliminary activity before conducting formative evaluation (one-to-one, small group, and field trial). Formative evaluation is a way to collect data or information to improve the effectiveness of the developed learning (Dick et al., 2015).

Expert review is conducted to ensure the feasibility and suitability between the general learning objectives, specific learning objectives, learners and context, assessment instruments with learning strategies, and teaching materials. Experts possessing the necessary expertise must conduct expert reviews to ensure their quality (Fu et al., 2025). The information obtained from formative evaluation is subsequently analyzed, and according to Tessmer (1993), the purpose of formative evaluation data analysis is to organize the information to make revision decisions. The final result of formative evaluation is to ensure the feasibility and effectiveness of the developed learning model for use with actual students and learning.

The IA toothbrushing skill learning model based on 3D printing for early childhood has three learning stages: presentation, practice, and independent practice. I and A refer to specific techniques for brushing different parts of the teeth. Technique I is for brushing the sides of the teeth that face the lips and cheeks, and technique A is for brushing the chewing surfaces and the sides that face the tongue and palate. The IA tooth brushing technique was developed to help young children remember the stages of brushing their teeth. Draft 1 of the developed teaching materials includes a tooth-brushing skills learning module for teachers and a 3D-printed IA teeth and mouth model to train the stages and techniques of IA tooth brushing, which can be described as follows.

Figure 1. Draft 1 of the module content, 3D printing model of teeth and mouth

In connection with the importance of feasibility evaluation before the developed learning model is evaluated by users through formative evaluation, this research aims to evaluate the feasibility of the IA tooth brushing skills learning model 3D printing-based for early childhood, which was developed through expert review.

B. METHOD

The research method used to evaluate the feasibility of the IA tooth brushing skills learning model 3D printing-based for early childhood, developed using expert review, can be described as follows:

1. Method

Expert review is part of formative evaluation, serving as a preliminary activity before the learning model is evaluated by users through formative evaluation with the aim of ensuring that the developed learning model meets the elements of feasibility. The task of the expert review is to conduct verification and feasibility assessment, as well as to provide improvement recommendations for the developed learning model.

2. Selection of Expert Staff

The experts involved have educational backgrounds, expertise, and experience relevant to their fields, namely early childhood education specialists, learning media specialists, and learning design specialists. The experts consist of four specialists, each with at least a doctoral degree and 15–36 years of work experience in their respective fields. The experts come from Universitas Negeri Jakarta, Universitas Terbuka, and Universitas Ibnu Chaldun.

3. Instrument

The evaluation instrument uses interview guidelines and open-ended question questionnaires. Each expert was provided with an evaluation instrument with indicators of the feasibility of the learning model according to their field of expertise. The material feasibility indicator has 15 questions, the learning media feasibility indicator has 21 questions, and the learning design has 28 questions. The research instrument, before being used by experts, was first validated by expert with a background in educational research and evaluation.

4. Procedure

The selected experts were given a letter of approval to evaluate the developed IA tooth-brushing skills learning model. The materials related to the learning model were first provided to the experts, and a follow-up meeting was scheduled to conduct interviews and clarify the evaluation results in the form of suggestions for improvements or revisions that need to be made. The results of the revisions are consulted again until they are deemed suitable for use.

C. RESULTS AND DISCUSSION

1. Result

Based on the experts' review of the IA tooth-brushing skills learning model 3D printing-based, the feedback is divided into three areas: subject matter experts, learning media, and learning design. The early childhood education experts, consisting of two individuals, evaluated the tooth-brushing skills material based on 15 criteria. These criteria included its alignment with the early childhood education curriculum, its ability to help children understand and encourage healthy living, its promotion of children's independence, its accurate coverage of information, its correct organization of content, its inclusion of accurate concepts and facts, its consistent and accurate use of terms, its reliable reference materials, and

its seamless integration with teaching methods. Recommendations for material improvements from both experts are summarized in Table 1.

Table 1. Recommendations for model improvements from experts in early childhood education materials

No	Indicator	Recommendation for improvement
1	The material on toothbrushing skills aligns with the learning objectives. objectives	Add learning outcomes and objectives to each learning activity.
2	The material on tooth-brushing skills aligns well with the characteristics of early childhood children.	Add instruction notes to the students' worksheets. The picture is too complex for the child to cut out easily.
3	The material on tooth brushing skills aligns with the learning outcomes.	Add more detailed information regarding soft toothbrush bristles.
4	The materials on dental brushing skills for early childhood are complete.	Add the caption "Guide for Teachers" to the module cover. An example of a cavity should ideally be repaired with a real image of a cavity. Accuracy in the use of terms/words
5	The material teaches children to live frugally by using mouthwash and toothpaste as needed.	Add information for the material on water conservation.
6	The alignment of the material with evaluation techniques is crucial for achieving learning objectives.	There needs to be a rubric for assessing success in the final assessment and a score threshold for remedial action. Moving the answer column, criteria, and sub-indicators on the assessment rubric. There needs to be a score descriptor on the observation sheet.

The teeth and mouth model teaching aid made with 3D printing, according to material experts, is excellent, safe for children, easy to hold, easy to use, aligned with the material and objectives, and not easily damaged. The follow-up was carried out by making improvements according to the provided suggestions. The results of the evaluation by learning media experts regarding the teaching materials in the form of modules and 3D printing dental and oral model learning media developed, as well as other supporting facilities for the tooth brushing skills learning model, have been declared suitable in terms of the alignment of learning media with learning objectives (relevance, suitability with the characteristics of early childhood, training tooth brushing skills), media quality (attractive, reusable, usable by individuals and groups, proportional size, color and shape similar to the original), technical quality feasibility (material strength, not sharp or pointed, child-safe materials), appearance and quality of the learning module (cover design, font selection, color sharpness, paper quality, color selection). The recommendations for improving the teaching materials are provided in Table 2.

Table 2. Recommendations for improving teaching materials from learning media experts

No	Indicators	Recommendation for improvement
1	Media supports the delivery of learning materials.	Add instructions for use on teeth and mouth model media for 3D printing Add flipcharts/posters/leaflets as learning media for students.

2	The ease of using learning media by teachers and children	Provide identity for the media because of the new product.
3	Module display	Design the module cover to make it more attractive

The evaluation results from learning design experts on the IA tooth brushing skills learning model, which has 28 indicators, show that it fits well with the early childhood education curriculum, the needs of young children, the development of skills and learning goals, teaching strategies, how the material is organized, how easy it is to understand, the methods used for learning, the level of interaction, the completeness of the learning materials, and how well the evaluation tools match the areas of learning achievement. Table 3 lists recommendations for improvements related to the learning design.

Table 3. Recommendations for model improvement from learning design experts

No	Indicators	Recommendation for improvement
1	The suitability of the chosen learning strategy to achieve learning outcomes	The teacher-student ratio is adjusted according to the number of students to achieve effective learning
2	Media supports in facilitating the delivery of learning materials.	Create a video to review the lesson, especially the tooth-brushing technique. Produce a series of short videos that demonstrate all the steps involved in brushing teeth

All improvement suggestions for enhancing the effectiveness of the learning model are followed up with revisions. The subsequent improvements are re-consulted with each expert until approval is obtained and deemed suitable for use in learning. Several final displays of the revised learning model according to the improvement recommendations from the experts are shown in Figure 2.

Figure 2. Revised module, flipchart, IA dental and oral model, and educational video

2. Discussions

Based on the evaluation results conducted by experts regarding the IA tooth-brushing skills learning model in accordance with the established feasibility indicators, there are several improvement recommendations that must be implemented to enhance the effectiveness of the learning model. The recommendations are followed up to ensure that the learning objective of 5-6-year-old children becoming skilled at brushing their teeth independently can be achieved. The experts chosen are aligned with their fields of expertise in education, enabling them to provide high-quality improvement recommendations that meet the required scientific standards and are appropriate for early childhood characteristics. The learning model that has

met the feasibility criteria based on expert evaluation will subsequently be used in three stages of formative evaluation, namely one-to-one, small group, and field trial, to obtain improvement recommendations from users.

The main learning media used in this tooth-brushing skills learning model employs 3D printing technology to create learning media in the form of a teeth and mouth model that closely resembles the original shape. The 3D learning media in the shape of teeth and mouth IA is used to train children in brushing techniques, making it easier for learners to recognize and adapt to their own teeth and mouth and to effectively clean food residues. This is in accordance with the opinion of Kalaskar (2017) that 3D printing is a technology that prints files into three-dimensional objects through a series of layers printed layer by layer. McMenamin et al. (2021) also state that 3D printing allows for the reproduction of anatomical body form copies in large quantities that can be used for classroom teaching. The improvements suggested by subject matter experts regarding the addition of learning outcomes and objectives in each learning activity are in accordance with the learning components required by Reigeluth (2009), which state that learning components must include clear information, namely learning objectives, the knowledge required, and the expected performance. In addition, the learning components must also include exercises, informative feedback, and the ability to foster strong intrinsic and extrinsic motivation.

The IA tooth-brushing skills learning model is used for students aged 5-6 years, so the teaching materials used must be appropriate for the characteristics of early childhood. The subject matter expert provided recommendations for improvements to adjust the worksheets so that they are not too difficult and can be performed by children. The worksheets provided are related to images associated with the activity of brushing teeth, and the students are asked to cut out or color these images. The ease of cutting or coloring the worksheets recommended by experts, according to the opinion of Pfeiffer & Clevenger (2025), is that physical activities for early childhood not only train motor skills but also need to develop social aspects through play. The revision of the worksheets is carried out so that children find it easy to complete them in a pleasant atmosphere. Recommendations for improvement by subject matter experts were also provided regarding the evaluation instruments to make them more detailed and comprehensive in measuring the ability to brush teeth independently. Brushing skills are a psychomotor domain, and learning success is assessed using an observation sheet based on an evaluation rubric. This is in accordance with the opinion of Buta et al. (2016), that assessment instruments must be carefully considered in accordance with the objectives, domain, and validation of the suitability of the instruments used.

Experts in learning media suggest enhancing the delivery of material to students by incorporating additional media. Since the students are 5-6 years old, learning media that is easy to understand, with more pictures and less text, is needed. The chosen learning medium to follow up on the improvement recommendations is a flipchart to align with the cognitive domain aimed at understanding the importance of dental health maintenance before moving on to the stage of practicing and independently brushing teeth. This is in line with the opinion of Kirkorian & Horgan (2023), that early childhood learns from educational media to acquire knowledge and skills with accurate information in various domains, thereby being able to apply it to new contexts influenced by the characteristics of the content, the child, and the

context. Another suggestion from the learning media expert is to provide identity and usage instructions for the newly developed 3D printing teeth and mouth models, as it is a new product. This approach is in line with the opinion of Parawansa (2024) that new products need to be given an identity to make it easier for consumers or users to identify and recognize them by building a strong and consistent image. The IA teeth and mouth model has a sticker with its name and usage instructions to help teachers and students use it in learning.

Learning design experts note the importance of considering the teacher-student ratio during the implementation of lessons on tooth brushing skills so that the learning is effective and the learning objectives can be achieved. The adequacy of the teacher-student ratio is ensured during the learning process, as tooth-brushing education requires guidance and positive feedback so that each student receives adequate attention at every stage of learning. The teacher-to-student ratio for children aged 4–6 years, based on Permendikbud Number 137 of 2014 concerning the National Standards for Early Childhood Education, is 1:15 (Permendikbud, 2014). The creation of educational videos is also recommended by learning design experts to facilitate teachers and students in reviewing the learning stages, especially the tooth-brushing technique. The position of the toothbrush varies on different surfaces of the teeth to effectively clean food residues. Repetition is necessary so that young children can remember and try to practice the IA tooth-brushing technique during independent practice at home. The initial learning related to the stages and techniques of brushing teeth is provided directly by the teacher at school, and the repetition of learning through videos is done at home. This situation is in line with the findings of Kuhlmann et al. (2024), that video-based learning will be most effective for students when there is cognitive engagement and prior knowledge.

Based on the initial design and improvement recommendations from experts, the strategy and teaching materials of the IA tooth-brushing skills learning model can accommodate visual, auditory, and kinesthetic learning styles in early childhood. Every stage of the learning process, including the presentation stage, practice stage, and independent practice, actively involves students in the learning strategy. Learning media are designed to be visually observable in the form of flipcharts containing images and minimal text, three-dimensional media that can be observed, handled, and used for repetitive tooth-brushing technique practice, and audiovisual learning videos for review. This is in line with the opinion of Jaleel & Thomas (2019), that each individual's learning style is different, so it is important for educators to determine what is most likely to trigger students to concentrate, stay focused, and respond naturally to produce memory and long-term retention of the new information they have learned. Recommendations for improving the learning model from experts have been followed up, so the model has been modified and declared very suitable for use in the next stage of formative evaluation.

D. CONCLUSION AND SUGGESTIONS

The evaluation by experts in early childhood education, learning media, and learning design shows that the IA tooth brushing skills learning model Based 3D printing for early childhood has improved in quality and meets the necessary standards, making it very effective for helping 5–6-year-olds learn to brush their teeth independently. For future researchers, to improve the feasibility evaluation results through expert review, the selection of experts in one

type of expertise can involve more than one expert so that the evaluation results are of higher quality, while still considering the adequacy of time and research costs.

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