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Research Article

Developing a PSADS-Based "Find Objects" Learning Media to Enhance Critical Thinking Skills of Third-Grade Elementary Students in Mathematics

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ABSTRACT

Purpose of the study: This study aims to develop and evaluate a PSADS-based "Find Objects" learning media that is valid, practical, and effective in enhancing the critical thinking skills of third-grade elementary school students in mathematics.

Methodology: The study employed a Research and Development approach using the ADDIE model. Data were collected through expert validation sheets, teacher and student questionnaires, classroom observations, and critical thinking tests. The test instruments were developed based on the FRISCO critical thinking indicators. Data analysis techniques included descriptive statistics, Kolmogorov–Smirnov normality tests, paired sample t-tests, and qualitative analysis using MAXQDA 2020 software.

Main Findings: The PSADS-based "Find Objects" learning media was categorized as feasible to very feasible by material, instructional design, and practitioner experts. Teacher and student responses indicated a high level of practicality. Statistical analysis revealed a significant improvement in students' critical thinking skills, with a mean score increase of 14.27 points. The paired sample t-test confirmed a significant difference between pre-test and post-test scores ($p < 0.05$).

Novelty/Originality of this study: This study fills a research gap in elementary mathematics education, where prior studies have largely emphasized instructional models or learning outcomes without integrating concrete visual media to systematically train critical thinking processes. The novelty of this study lies in the integration of the PSADS learning stages with a "Find Objects" card-based media that engages students in structured object-search, analysis, discussion, and reflection activities, thereby emphasizing critical thinking development rather than learning outcomes alone.

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1. INTRODUCTION

Twenty-first century education emphasizes the development of Higher Order Thinking Skills (HOTS), including critical thinking, creativity, collaboration, and communication. Among these competencies, critical thinking is a core skill that enables students to analyze information, justify reasoning, and solve problems logically from an early age [1]-[3]. In the Indonesian context, the Merdeka Curriculum explicitly promotes critical reasoning as a key dimension of the Pancasila Student Profile, particularly within mathematics learning outcomes at the elementary level [4], [5]. Therefore, learning in elementary schools must be designed to actively, deeply, and meaningfully foster students' critical thinking skills.

According to Piaget's theory of cognitive development (1970), from a developmental perspective, elementary school students are generally at the concrete operational stage, in which logical thinking emerges through direct interaction with concrete objects and contextual situations. Consequently, mathematics learning should be designed to bridge abstract concepts with students' real-life experiences. However, empirical studies indicate that elementary mathematics instruction remains predominantly teacher-centered and procedural, emphasizing memorization rather than conceptual understanding and reasoning [6]-[8]. As a result, many students experience difficulties when solving contextual problems and are unable to provide logical explanations for their answers, indicating limited critical thinking skills [9], [10]. These conditions highlights a critical problem in current instructional practices that must be addressed.

One instructional approach that has the potential to enhance students' thinking processes is the PSADS learning model (Problem, Search, Analyze, Discuss, Share). This model engages students in a structured inquiry process, guiding them to identify problems, seek relevant information, analyze findings, discuss solutions, and share conclusions collaboratively. These stages align with constructivist learning principles that emphasize active knowledge construction and reflective thinking [11]-[13]. Several previous studies shown that problem-based and inquiry-oriented learning models can effectively improve students' critical thinking and problem-solving abilities [14]-[16]. However, existing studies predominantly examine learning motivation or achievement outcomes, while research that integrates visual card-based media with a structured thinking model specifically to train elementary students' critical thinking skills remains limited.

In addition to instructional models, learning media play a crucial role in supporting students' understanding of mathematical concepts. According to Bruner's theory, effective learning progresses from enactive experiences to iconic representations and finally to symbolic abstraction [17]-[19]. Visual and game-based media, such as card-based learning tools, have been reported to increase students' engagement and learning motivation in mathematics [11]-[13]. However, studies that specifically develop visual card-based media integrated with the PSADS model to train elementary students' critical thinking skills remain limited. Most previous research has emphasized learning outcomes or motivation rather than higher-order thinking skills.

Based on this review, there is a need for instructional innovation that combines the strengths of the PSADS model with engaging concrete media suitable for elementary school students. Accordingly, this study develops a "Find Objects" learning media based on the PSADS model as an alternative solution to stimulate students' critical thinking skills in mathematics learning. This media is designed in the form of illustrated cards that enable students to observe, classify, and analyze objects critically through search-based game activities[23]-[25]. Such an approach allows students to think systematically in finding solutions to the given problems. The novelty of this study lies in the integration of the interactive "Find Objects" card-based media with the stages of the PSADS model in the context of elementary mathematics learning. Previous studies, such as those conducted [26], [27], have demonstrated the effectiveness of Project-Based Learning and Problem-Based Learning models in enhancing critical thinking skills; however, limited research has focused on developing concrete media that emphasize students' systematic thinking processes. Therefore, this study is expected to contribute a new perspective to the innovation of mathematics learning media that can develop critical thinking skills from an early age in an enjoyable and meaningful manner.

Therefore, this study aims to develop a PSADS-based "Find Objects" learning media that is valid, practical, and effective in improving elementary school students' critical thinking skills in mathematics. This study is guided by two research questions, namely whether the PSADS-based "Find Objects" learning media is valid and practical for use in elementary mathematics learning, and whether it is effective in enhancing students' critical thinking skills. Through this development, mathematics learning is expected to become more contextual and engaging, while also supporting the strengthening of critical reasoning in accordance with the Merdeka Curriculum and the Pancasila Student Profile.

2. RESEARCH METHOD

This study employed a Research and Development (R&D) method aimed at producing PSADS-based "Find Objects" learning media (Problem, Search, Analyze, Discuss, Share) that are feasible for use in elementary school mathematics learning [28], [29]. The development model applied was the ADDIE instructional design

model, which consists of five systematic stages analysis, design, development, implementation, and evaluation originally developed by Dick and Carey in 1996 to support the development of instructional products [30].

Figure 1. ADDIE Development Model

The media development was intended to produce a learning product that is valid, practical, and effective in enhancing students' critical thinking skills, in line with the demands of the Merdeka Curriculum and the reinforcement of critical reasoning competencies[31]-[33]. The feasibility of the Find Objetcs learning media was determined through expert validation using a five-point Likert scale, ranging from Strongly Disagree (1) to Strongly Agree (5). The feasibility percentage was calculated using the following formula:

$$P = \frac{Actual\ Score}{Ideal\ Score} \times 100\% \ldots (1)$$

Description
P : The percentage of each indicator
$Actual\ Score$: The score assigned by expert validators
$Ideal\ Score$: The maximum possible score obtained by multiplying the number of items by the highest score on the rating scale.

Where Actual Score refers to the score assigned by expert validators, and Ideal Score represents the maximum possible score obtained by multiplying the number of items by the highest score on the rating scale.

Table 1. Results of expert validation of the Find Objetcs learning media

Category	Score
Strongly disagree	1
Don't agree	2
Slightly Disagree	3
Agree	4
Strongly Agree	5

Table 2. Conversion of Achievement Levels

Interval (%)	Category
81.0 – 100.0	Very High
61.0 – 80.0	High
41.0 – 60.0	Moderate
21.0 – 40.0	Low
10.0 – 20.0	Very Low

The achievement level categories presented in Table 2 are used as general benchmarks for data interpretation. These categories are applied according to the constructs being assessed, namely feasibility in expert validation results and students' critical thinking skills. The study was conducted from the second semester of the 2024/2025 academic year to the first semester of the 2025/2026 academic year in several elementary schools in Salatiga City and its surrounding areas. The research participants consisted of three groups, selected using purposive sampling based on specific criteria relevant to the research objectives. The first group comprised subject matter experts, learning experts, and practitioner experts who were involved in the validation of the learning media. These experts were selected based on their academic qualifications, professional experience, and

expertise in mathematics education and instructional design. The second group included third-grade elementary school teachers who evaluated the practicality of the media in classroom implementation. The third group consisted of third-grade elementary school students who participated in the limited trial phase and served as users of the developed media. The selection of students was based on their active involvement in mathematics learning activities relevant to the scope of the study.

The research procedures were carried out through the five ADDIE stages. The analysis stage involved curriculum analysis, teacher interviews, and classroom observations to identify instructional problems, students' learning characteristics, and media needs. The design stage focused on planning the learning media structure and developing the initial prototype of the PSADS-based "Find Objects" cards. During the development stage, the prototype was refined based on expert feedback obtained through validation instruments. The implementation stage involved revising the media according to validation results and conducting limited trials in third-grade classrooms. Finally, the evaluation stage was conducted to assess the validity, practicality, and effectiveness of the media in supporting students' critical thinking skills.

Data collection employed multiple instruments aligned with the research objectives. Validity data were obtained using expert validation sheets completed by subject matter experts, learning experts, and practitioner experts. Practicality data were collected through questionnaires administered to teachers and students after using the media. Effectiveness data were gathered through a critical thinking skills test administered before and after the implementation of the media. The critical thinking test instrument was adapted from the FRISCO critical thinking framework (Focus, Reason, Inference, Situation, Clarity, and Overview) developed by Ennis, with contextual adjustments made to suit elementary mathematics learning. The instrument was reviewed by experts to ensure content validity and subsequently tested for reliability.

Instrument reliability was analyzed using Cronbach's alpha coefficient. The results indicated that the critical thinking test instrument had a Cronbach's alpha value of $\alpha \geq 0.70$, which demonstrates acceptable internal consistency and reliability for research purposes. The validation and reliability testing ensured that the instruments were appropriate for measuring the intended variables. The variables in this study consisted of media feasibility, media practicality, and students' critical thinking skills. Media feasibility was measured based on expert validation scores covering content relevance, instructional design, language clarity, and visual presentation. Media practicality was measured through teacher and student response questionnaires focusing on ease of use, attractiveness, and instructional usefulness. Students' critical thinking skills were measured using pre-test and post-test scores derived from the FRISCO-based critical thinking indicators.

Data analysis techniques included descriptive quantitative analysis, normality testing, and effectiveness testing. Descriptive analysis was used to determine the feasibility and practicality levels of the media based on percentage scores, which were classified into categories ranging from very feasible to not feasible [34]-[36]. Media effectiveness data were analyzed using a paired sample t-test to measure differences in students' critical thinking abilities before and after the use of the media at a significance level of 0.05. The results of this analysis were used to determine whether the PSADS-based "Find Objects" learning media are appropriate for implementation in mathematics instruction.

This study did not utilize student response questionnaires or psychometric measurement scales; therefore, internal consistency reliability analysis using Cronbach's alpha was not applied, as such procedures are relevant only for questionnaire-based instruments intended to assess latent constructs. Instead, the reliability of the instruments was established through expert consensus and the use of consistent scoring guidelines based on predetermined creativity indicators, ensuring inter-rater consistency in the assessment of student performance.

3. RESULTS AND DISCUSSION

This study focuses on the development of PSADS-based "Find Objects" learning media (Problem, Search, Analyze, Discuss, Share) using a Research and Development (R&D) approach. The development model employed is ADDIE, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation [37]. Each stage was conducted systematically to produce learning media that are valid, practical, and effective in enhancing elementary school students' critical thinking skills.

Analysis

The analysis stage was conducted through interviews with teachers and students, as well as classroom observations of the learning process in Grade III elementary school. The qualitative data were analyzed using MAXQDA 2020 software to map the relationships among codes derived from interview and observation data. The results of the analysis indicate that mathematics instruction in elementary schools is still predominantly characterized by lecture-based methods, with learning media largely limited to textbooks and the whiteboard. This condition leads to low levels of student engagement in learning activities.

The network map generated from the analysis reveals that limited learning media constitute a primary factor contributing to students' low enthusiasm and critical thinking abilities. Teachers also emphasized the need

for more engaging, varied, and contextual learning media to foster students' learning motivation and to support their understanding of abstract mathematical concepts.

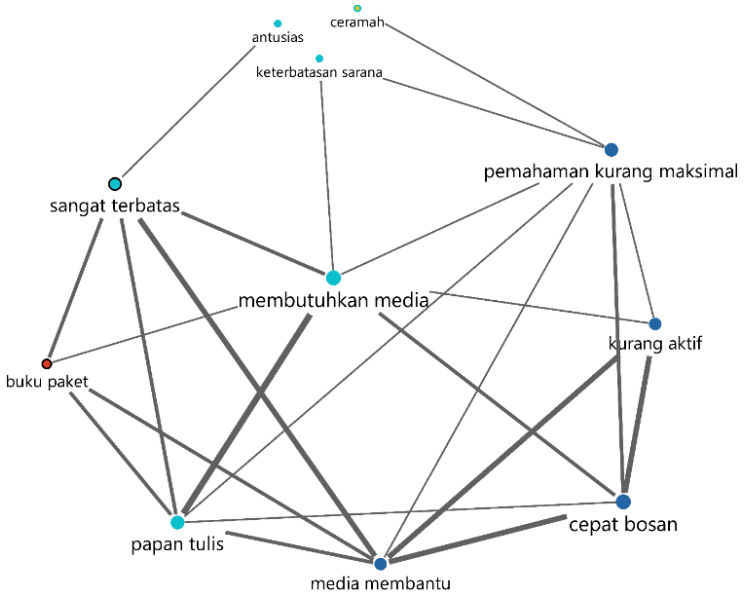


Figure 2. Network Map of Interview and Observation Results

Design

The design stage resulted in an initial draft of the "Find Objects" learning media, developed based on the needs analysis findings. The media were designed in the form of 20 visual cards featuring concrete objects familiar to students' daily environment, such as tables, chairs, books, pencils, and rulers. Each card consists of two sides: the front side displays an image of the object, while the back side contains symbols or cues used to support learning activities. In addition to the cards, a storage box, Student Worksheets (LKPD), and a media usage guide were also designed. All components were developed to align with the PSADS learning model, which encourages students to identify problems, search for information, analyze data, engage in discussions, and share their findings**.**

Table 3. Design of the "Find Objects" Learning Media

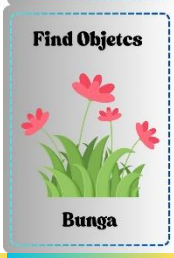
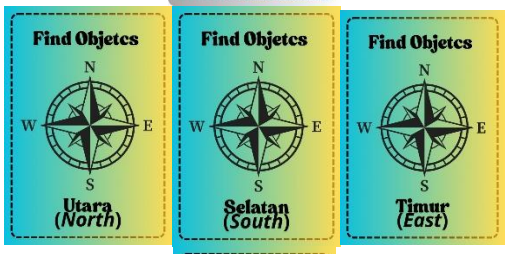
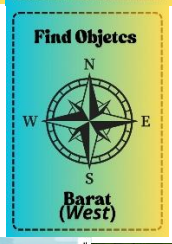
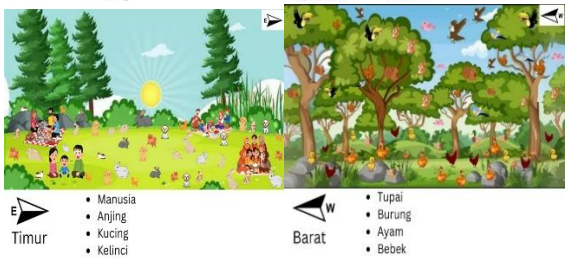
Component	Description
Media Card	20 cards containing pictures of concrete objects around students
Worksheet	Contains steps for activities based on the PSADS model.
Media Box	Attractive visual design on each side of the box
Teacher's Guide	Instructions for media use and integration into learning

Development

The development stage involved the realization of the conceptual design into a tangible product. The "Find Objects" learning media were refined based on guidance and initial validation results. A major modification was made to the card structure by grouping the objects into four categories, each consisting of five cards, to facilitate the organization of student learning groups. In addition, a master card indicating cardinal directions, the "Find Objects" game board, and the final version of the student worksheets were developed. This development expanded the function of the media from a mere visual aid into an interactive learning tool that supports collaboration and spatial thinking.

Table 4. "Find Objects" Learning Media

Media Images	Information

Media Images	Information
	Find Objects Board
	Find Objects Cards
	
	Master Card
	
	Master Image
	

Implementation

The implementation stage was conducted in Grade III elementary school classrooms involving both teachers and students. The “Find Objects” learning media were evaluated through validation by subject matter experts, instructional design experts, and practitioner experts to assess the feasibility of the content, visual design, and practicality of the media.

Table 5. Results of Subject Matter Expert Validation

Aspect	Score	Percentage	Categories
Focus	8	74%	Feasible
Reason	7		
Inference	7		
Situational	7		
Clarity	4		
Overview	4		
Total	37	74%	Feasible with Minor Revisions

Table 6. Results of Instructional Design Expert Validation

Aspect	Score	Percentage	Categories
General Information	14	90%	Very Feasible
Core Components	26		
Appendices	5		
Total	45	90%	Very Feasible

The following presents the results of practitioner expert validation on the use of the "Find Objects" learning media in instructional practice.

Table 7. Results of Practitioner Expert Validation

Subject	Score	Percentage	Categories
Teacher 1	112	90%	Very Feasible
Teacher 2	120	96%	Very Feasible
Teacher 3	102	82%	Feasible

The validation results indicate that the "Find Objects" learning media meet the feasibility criteria in terms of content, design, and practicality. Feedback from the validators was used to improve visual clarity, usage instructions, and the organization of the student worksheets to make them more communicative and user-friendly.

Evaluation

The evaluation stage was conducted to measure the effectiveness of the learning media in improving students' critical thinking skills and learning outcomes. The effectiveness testing was carried out in four elementary schools in Salatiga City and its surrounding areas: SD Negeri Salatiga 06, SD Kristen 04 Salatiga, SD Kanisius Cungkup, and SD Negeri Kebondowo 02.

Table 8. Results of Descriptive Statistic

	N	Minimum	Maxium	Mean	Std. Deviation
Score	192	41	90	69.45	12.733
Class	192	1	4	2.52	1.193
Valid N (listwise)	192				

The mean post-test score increased by 14.27 points compared to the pre-test score, indicating an improvement in students' critical thinking skills after the implementation of the "Find Objects" learning media.

Table 9. Results of the Kolmogorov–Smirnov Normality Test

Class	Statistic	df	Sig
Elementary School Salatiga 06	.112	56	.076
Elementary School Kristen 04 Salatiga	.111	36	.200*
Elementary School Kanisius Cungkup Salatiga	.130	44	.059
Elementary School Kebondowo 02	.112	56	.078

The normality test results indicate that all data are normally distributed ($p > 0.05$). Subsequently, a paired sample t-test was conducted to determine the effectiveness of the learning media.

Table 10. Results of the Paired Sample t-Test

	Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig (2-tailed)
Class - Results	66.927	12.668	.914	65.124	68.730	73.206	191	.000

Based on the results of the statistical test, the calculated t-value was 73.206 with a significance value (Sig.) of 0.000 (< 0.05), indicating a significant difference between learning outcomes before and after the implementation of the Find Objects media. These findings demonstrate that PSADS-based learning media are effective in improving elementary school students' critical thinking skills.

The research findings indicate that the development of Find Objects learning media based on the PSADS model (Problem, Search, Analyze, Discuss, Share) effectively improves elementary school students' critical thinking skills. These findings are consistent with constructivist theory, which emphasizes that knowledge is actively constructed by learners through direct experience, social interaction, and reflection on the learning process [38], [39]. The "Find Objects" media provides students with opportunities to interact with concrete representations of mathematical concepts, discuss their observations with peers, and justify their reasoning during the PSADS stages. This process allows students to construct meaning gradually, rather than passively receiving information, thereby fostering more sustainable learning outcomes.

The analysis stage of this study revealed fundamental problems in mathematics learning, namely low student engagement caused by the dominance of lecture-based methods and the limited use of varied learning media. Such conditions suggest that purely conventional instruction tends to make students passive and does not support the development of higher-order thinking skills. Innovative learning media play an important role in encouraging both independent and collaborative student learning activities [37]-[39]. At the design stage, the Find Objects media were developed to address the need for learning that is contextualized to students' daily lives. This media allows students to learn through visual experiences and the exploration of concrete objects, which aligns with the concrete operational stage of cognitive development [40]-[42]. The media design, which integrates visual elements, game-based activities, and discussion, was proven to enhance students' motivation and engagement during the learning process. This is in line with the view that visual media can strengthen students' memory and increase active learning [43]. Findings from the development stage show that the Find Objects media met the instructional design principles of the ADDIE model, which emphasizes product effectiveness. Expert validation results indicated a very high level of feasibility: material experts awarded a score of 74% (feasible), instructional design experts 90% (very feasible), and practitioner experts scores ranging from 82% to 96% (feasible to very feasible). This high feasibility level indicates that the media not only aligns with the characteristics of elementary school students but is also relevant to teachers' needs as learning facilitators. These results are consistent with the notion that the quality of educational development products can be assessed through content validity, practicality, and learning effectiveness [44].

The implementation stage demonstrated that the Find Objects media received positive responses from both teachers and students. Teachers reported that the media was easy to use, practical for classroom implementation, and capable of increasing students' enthusiasm and participation. Meanwhile, students showed a high level of interest in the visual format and object-search activities embedded within the PSADS model. This further indicates that problem-based concrete media can enhance critical thinking skills while simultaneously motivating students to engage more actively in learning [45], [46]. The PSADS model itself has been shown to effectively facilitate analytical thinking processes through its systematic stages: identifying problems, searching for information, analyzing solutions, discussing results, and sharing findings. Furthermore, the effectiveness test using a Paired Sample t-Test yielded a calculated t-value of 73.206 with a significance value of 0.000 (< 0.05), indicating a significant difference between learning outcomes before and after the use of the Find Objects media. This finding strengthens the assumption that PSADS-based media have a tangible impact on improving critical thinking skills. Descriptively, the average learning outcome increased from 69.45 in the pre-test to 83.72 in the post-test, representing an improvement of 14.27 points, which confirms the effectiveness of the media in achieving mathematics learning objectives. Other studies have also shown that the use of activity-based and contextually visualized media can enhance elementary school students' critical thinking skills and conceptual understanding. When combined with concrete media, such approaches are able to stimulate students' analytical and problem-solving abilities [44]-[46]. Thus, the findings of this study not only support constructivist learning theory but also reinforce previous research on the effectiveness of interactive media in improving critical thinking skills. In the context of this study, the visualization of concrete objects on the Find Objects cards serves as a bridge between real-life experiences and abstract mathematical concepts [47]-[50]. The play-based learning activities also foster an enjoyable learning environment, thereby increasing students' intrinsic motivation to think and analyze problems. Moreover, students' active involvement at each stage of the PSADS model demonstrates that this media aligns with the student-centered learning approach promoted in the Merdeka Curriculum. This model supports teachers in their role as facilitators who encourage students to think independently, ask questions, and collaborate. Consequently, the findings of this study highlight the importance of using activity-based and visual-exploration learning media in elementary school mathematics instruction.

Overall, this study confirms that the PSADS-based "Find Objects" learning media represents a valid, practical, and effective instructional innovation for improving elementary school students' critical thinking skills. The findings provide empirical support for the use of structured, activity-based, and visually

contextualized learning media as a means to promote meaningful mathematics learning and align instructional practices with the goals of contemporary curricula.

4. CONCLUSION

This study concludes that the PSADS-based "Find Objects" learning media represents an effective instructional approach for fostering elementary school students' critical thinking skills in mathematics. By integrating structured problem-solving stages with concrete and visually contextualized media, the learning process supports students' abilities to analyze, reason, and draw conclusions meaningfully. This finding reinforces constructivist learning theory by demonstrating that critical thinking skills can be systematically developed at the elementary level when inquiry-based learning models are operationalized through developmentally appropriate media. The study contributes to the literature by offering empirical evidence on the integration of the PSADS model with card-based visual media as a practical framework for critical thinking development in elementary mathematics. Practically, the findings support the implementation of student-centered and higher-order thinking-oriented instruction as promoted by the Merdeka Curriculum and the Pancasila Student Profile. From a policy perspective, this study highlights the need for instructional media innovations that explicitly train critical reasoning skills and are feasible for classroom use. Future research is recommended to expand the application of this media across broader contexts, examine its long-term impact, and explore digital adaptations to enhance scalability and instructional flexibility.

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AUTHOR CONTRIBUTIONS

Conceptualization, A.F.D.P.; Methodology, A.F.D.P.; Software, A.F.D.P.; Validation, H.L.M. and W.H.K.; Formal Analysis, A.F.D.P., H.L.M. and W.H.K.; Investigation, A.F.D.P.; Resources, A.F.D.P.; Data Curation, A.F.D.P.; Writing Original Draft Preparation, A.F.D.P.; Writing Review & Editing, A.F.D.P., H.L.M. and W.H.K.; Visualization, A.F.D.P.; Supervision, H.L.M. and W.H.K.; Project Administration, A.F.D.P.; Funding Acquisition, A.F.D.P.

CONFLICTS OF INTEREST

The author(s) declare no conflict of interest.

USE OF ARTIFICIAL INTELLIGENCE (AI)-ASSISTED TECHNOLOGY

The authors declare that no artificial intelligence (AI) tools were used in the generation, analysis, or writing of this manuscript. All aspects of the research, including data collection, interpretation, and manuscript preparation, were carried out entirely by the authors without the assistance of AI-based technologies.

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