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Research Article

STRATEGIES TO ENHANCE DECISION MAKING AND DESIGN THINKING SKILLS FOR INDUSTRIAL DESIGN STUDENTS

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Abstract
The low levels of decision-making skills (DMS) and design thinking skills (DTS) among Industrial Design Engineering students in Bali hinder their readiness to meet industry demands. This problem is compounded by students' low self-efficacy in making career decisions and their limited exposure to authentic, collaborative, and interdisciplinary training. This study aims to address these gaps by implementing and evaluating a transformative multicultural education model as an innovative strategy to enhance DMS and DTS. Employing an experimental research design, the study involved 64 vocational schools (SMK) across Bali, selected to represent diverse cultural and socio-economic contexts. Data were collected through validated structured questionnaires measuring DMS and DTS, followed by quantitative analysis using descriptive statistics and MANOVA. The findings reveal that the transformative multicultural learning model produced a statistically significant improvement in both skill domains, fostering not only technical creativity but also culturally responsive decision-making. The novelty of this research lies in its integration of multicultural perspectives directly into the design thinking framework—positioning cultural diversity as an active driver of creative problem-solving rather than a passive background element. Furthermore, the approach embeds real-world project simulations grounded in local cultural values, bridging the gap between academic preparation and industry expectations. This combination of cultural adaptation, critical thinking, and collaborative design creates a robust foundation for inclusive, future-ready learning environments. The results suggest that transformative multicultural education can serve as a scalable, culturally relevant model for preparing students to navigate complex, globalized work environments while retaining local identity.

Keywords Decision Making, Design Thinking, Industrial Design Engineering, Multicultural Education

INTRODUCTION

Industrial design engineering education plays a crucial role in developing professional competencies and preparing students for the challenges of an increasingly complex industrial environment (Jiang & Zhang, 2021; Tan & Umemoto, 2021; Kumi-Yeboah & Amponsah, 2023). The success of this educational field depends heavily on the alignment between academic learning and industry demands, as emphasized by previous studies highlighting the importance of collaboration between educational institutions and the industrial sector (Pan et al., 2020; Meirawan et al., 2022; Anugradia et al., 2025). Such collaboration aims to produce graduates equipped not only with strong theoretical knowledge but also with practical, industry-relevant skills (Nouri, 2022; Theobald et al., 2023).

A key pedagogical foundation in industrial design engineering is the competency-based educational approach, which ensures that curricula remain relevant to technological and industrial developments (Garcia-Garcia et al., 2021; Srisawat et al., 2023; Kian et al., 2024; Ikhsan et al., 2025). This approach integrates innovative design technologies—such as generative design—which have been shown to enhance efficiency and creativity in manufacturing processes (Fildansyah et al., 2023). Consequently, industrial design engineering programs must adapt to evolving technological landscapes to maintain relevance and provide added value for graduates (He & Yang, 2020; López et al., 2024; Sidhu et al., 2024). Beyond technical expertise, students must also develop essential soft skills—particularly decision-making—to navigate the complexities of the modern industrial sector.

Decision-making is a vital cognitive skill that enables individuals to select appropriate strategies and actions in diverse problem contexts (Goosen & Steenkamp, 2023; Kaynak et al., 2023). For students, decision-making is not only part of daily academic and personal life but also a critical factor in career planning and industrial problem-solving (Waschwill et al., 2020; İlaslan et al., 2023; Jumaera et al., 2024; Kheang et al., 2025; Nou et al., 2025). In the context of industrial design engineering, strong decision-making abilities support strategic thinking, risk assessment, and problem resolution in high-stakes environments (Karakullukçu et al., 2019; Obenza et al., 2025; Putri et al., 2025). These abilities are reinforced by critical and analytical thinking skills, which enable students to approach complex industrial problems systematically (Figueiredo & Jorge, 2018; Kans, 2020; Morris et al., 2020; Lestari et al., 2020; Pamungkas et al., 2020; Irfana et al., 2022; Jarnawi et al., 2025; Jalmasco et al., 2025).

Alongside decision-making, design thinking is another essential skill for industrial design engineering students. Design thinking is an iterative, human-centered problem-solving process involving empathy, problem definition, ideation, prototyping, and testing (Kavousi et al., 2019; Simon & Cox, 2019; Bender-Salazar, 2023; Juniantari et al., 2023). Its application in education fosters collaboration, creativity, critical thinking, and adaptability—qualities that are indispensable in today's rapidly changing industrial world (Alghafri & Ismail, 2014; Pande & Bharathi, 2020; Mohamad et al., 2021; Fatmawati et al., 2022). By integrating decision-making and design thinking into the curriculum, students can acquire both the technical and interpersonal skills—such as communication and teamwork—needed for professional success.

However, despite the recognized importance of these skills, industrial engineering students in Bali exhibit low levels of decision-making and design thinking ability. This limitation reduces their readiness for the workforce and their capacity to innovate. One contributing factor is the low *Career Decision-Making Self-Efficacy* (CDMSE) among students, which has been positively correlated with career persistence and long-term goal achievement (Ramadhani & Hardew, 2024). Students with low self-efficacy often experience indecision and hesitation in career-related choices, which in turn hinders their creative problem-solving capacity (Karim & Rasdi, 2021; Kurniawati & Putri, 2021; Febrianti & Royani, 2023; Rachmatika & Salighehdar, 2024). Additionally, insufficient practical training and limited exposure to collaborative, problem-based projects further constrain the development of these abilities. While research suggests that problem-based learning can enhance both decision-making and design thinking (Ahmad & Wrahatnolo, 2024; Rubio et al., 2025; Salim et al., 2025), its implementation in Bali remains sporadic and isolated.

Given these challenges, there is a pressing need for a teaching approach that simultaneously strengthens technical competencies and soft skills. One promising strategy is transformative multicultural education, which integrates cultural diversity awareness into the learning process. This approach can foster critical thinking, creativity, and collaborative skills while promoting inclusive perspectives (Jayadi et al., 2022; Mardhiah et al., 2024; Somantri, 2024; Siddique et al., 2025). By exposing students to diverse viewpoints, multicultural education helps them appreciate differences, resolve conflicts constructively,

and design products that are both innovative and culturally relevant (Kustati et al., 2020; Praswanti & Siswanto, 2023; Rudianto, 2023; Khair et al., 2024). Furthermore, collaborative projects in multicultural contexts enhance students' ability to think inclusively and generate adaptable, market-oriented solutions (Arfa & Lasaiba, 2022; Pasek Suryawan et al., 2022; Windayani et al., 2024).

While existing studies have examined the relationship between decision-making, design thinking, and various pedagogical approaches, there is a lack of research that specifically addresses strategies to improve these skills through transformative multicultural education in the context of industrial design engineering students in Bali. Moreover, no previous study has systematically explored how multicultural learning environments can be structured to simultaneously enhance CDMSE, decision-making, and design thinking abilities in this population. Based on this gap, the present study aims to analyze the strategy of implementing a transformative multicultural education approach as a means to improve decision-making and design thinking skills among industrial design engineering students in Bali.

RESEARCH METHOD

This study employs an experimental research design aimed at testing the effectiveness of a transformative multicultural learning approach in enhancing decision-making and design thinking skills among Industrial Design Engineering students. The experimental design was chosen to allow for controlled comparisons between groups and to assess the causal impact of the intervention. The study utilizes both pre-test and post-test assessments to measure changes in students' skills, providing a robust framework for evaluating the influence of the multicultural-transformative model. Quantitative data analysis techniques, including descriptive statistics and MANOVA (Multivariate Analysis of Variance), are used to analyze the data and determine the significance of the findings.

The population of this study consists of 64 vocational schools (SMK) offering Industrial Design Engineering programs across all districts in Bali. Given the large and geographically dispersed population, the sample size was determined using the Slovin formula with a 3% margin of error, as recommended by Cohen et al. (2017) to ensure the reliability of the results. The sampling method used was cluster random sampling, which allows for the inclusion of schools from both suburban and urban areas within each district. This approach was intended to ensure that the sample accurately represents the diversity of educational settings in Bali, thus enhancing the generalizability of the study's findings.

This study was carried out through a structured series of steps designed to examine the effectiveness of a transformative multicultural learning approach in enhancing decision-making and design thinking skills among students majoring in Industrial Design Engineering in Bali. An experimental research design was adopted to allow for a controlled comparison between experimental and control groups. The target population consisted of 64 vocational high schools (SMK) offering industrial design programs across all districts in Bali. Due to the large and geographically diverse population, the sample size was calculated using the Slovin formula with a 3% margin of error, following the guidelines provided by Cohen et al. (2017). To ensure equitable representation, schools were selected using a cluster random sampling method, covering both urban and rural areas within each district.

Following the sampling process, data collection was conducted using two structured questionnaires aimed at measuring students' decision-making and design thinking abilities. These instruments were carefully developed based on theoretical foundations and underwent expert validation prior to implementation. The questionnaires contained 15 items each, aligned with specific skill indicators as outlined in the instrument grid. Students received clear instructions on how to complete the questionnaires, and the process was closely monitored to ensure independent and honest responses. A 4-point Likert scale was used to record responses, ranging from (1) Strongly Disagree to (4) Strongly Agree.

After data collection, the responses were analyzed using quantitative methods. Descriptive statistics were employed to interpret general trends and distribution patterns, while Multivariate Analysis of Variance (MANOVA) was used to examine the influence of the multicultural-transformative learning model on both decision-making and design thinking competencies. This structured research procedure was designed to ensure reliability and provide meaningful insights into the instructional impact on student skill development.

Data collection in this study used a structured questionnaire survey. Structured questionnaire surveys are used to measure students' design thinking skills and decision-making skills. The research questionnaire was distributed to selected sample schools. Participants will be given clear instructions on how to complete the questionnaire and responses will be collected within a specified time period. In

maintaining facilities and data rehabilitation, the administration process will be monitored and resulting in respondents completing the questionnaire independently. The instrument grid is presented in Table 1.

Table 1. Instrument Grid

Measured Competencies	Indicator	Question Number
Design Thinking Skills	Ability to identify problems creatively	1, 2, 3, 4
	Ability to generate innovative ideas	5, 6, 7, 8
	Ability to prototype and test solutions	9, 10, 11, 12
	Ability to implement and refine solutions	13, 14, 15
Decision-Making Skills	Ability to identify and define problems	1, 2, 3, 4
	Ability to collect and analyze information	5, 6, 7, 8
	Ability to evaluate and consider multiple options	9, 10, 11, 12
	Ability to make effective decisions	13, 14, 15

The research used consists of two structured questionnaires designed to measure critical social thinking skills and decision-making skills. The instrument was developed based on the theoretical framework that was validated by experts before being implemented in the study. The design thinking skills questionnaire can assess students' abilities in identifying problems, finding creative solutions, developing prototypes, and refining ideas. The Decision-making Skills Questionnaire focuses on students' abilities in analyzing problems, collecting formal information, considering various alternative solutions, and making effective decisions. Responses will be measured using a 4-Point close scale that aims to ensure that participants state a clear level of agreement or disagreement and is arranged with values (1) Strongly Disagree, (2) Disagree, (3) Agree, (4) Strongly Agree.

The research data were analyzed using quantitative data analysis techniques, namely descriptive analysis and inferential analysis using MANOVA (Multivariate Analysis of Variance). Descriptive analysis is used to summarize data distribution and identify, while MANOVA is used to test the effect of the safety of the transformative multicultural learning approach on decision-making skills and design thinking skills. This study aims to provide good and reliable insight into the impact of the transformative multicultural learning approach on the development of student skills in industrial engineering design education.

RESULTS AND DISCUSSION

Descriptive statistical analysis was used to assess the impact of the transformative multicultural approach on decision-making skills and critical perspective skills in industrial engineering design education students. The results of the data analysis are presented in the form of mean values, standard deviations, minimum scores, and maximum scores for both variables, presented in Table 2.

Table 2. Descriptive Statistics of Decision-Making Skills and Design Thinking Skills

Variable	N	Min	Max	Mean	Std. Deviation
Decision-Making Skills (DMS)	120	30	90	67.45	10.23
Design Thinking Skills (DTS)	120	35	95	72.38	9.87

Data analysis shows the average score of decision making skill is 64.45 and standard deviation is 10.23. The average score of design thinking skill is 72.38 and standard deviation is 9.87. The challenge of the score concludes that students generally perform well in both competencies with minimum scores of 30 and 35 and maximum scores of 90 and 95 respectively. In categorizing the level of student proficiency, the score is clarified into low-low (0-49), medium (50-74), and high (75-100) categories. The percentage distribution is presented in Table 3.

Table 3. Percentage Distribution of Decision-Making and Design Thinking Skills

Category	Decision-Making Skills (DMS)	Design Thinking Skills (DTS)
Low (0-49)	18.3%	12.5%
Moderate (50-74)	56.7%	60.0%
High (75-100)	25.0%	27.5%

The results of the data analysis presented in table 2 show that some students get scores in the medium category on DMS, namely 56.7% and DTS 60.0%. On DMS 25.0% of students get high decision-making skills and DTS, namely 27.5% high design thinking skills. 18.3% of students have low DMS scores, and 12.5% have low DTS scores showing that most have medium to high potential in both skills.

Prerequisite Test Analysis

The prerequisite test analysis was conducted to ensure normal data and homogeneity of the test points. This is very important in determining the right statistical approach in analyzing the impact of the transformative multicultural learning approach on decision-making skills and design thinking skills. The normality test used Kolmogorov-Smirnov and Shapiro-Wilk to assess the DMS and DTS scores following a normal distribution. The results of the normality test are presented in Table 4.

Table 4. Normality Test Results

Variable	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Decision-Making Skills (DMS)	0.092	120	0.078	0.981	120	0.112
Design Thinking Skills (DTS)	0.085	120	0.065	0.987	120	0.095

Data analysis in Table 3 shows that the significance value is greater than 6.05 so that both variables are normally distributed. These results conclude that parametric statistical tests such as Manova can be used for further analysis. The normal distribution of Decision-Making Skills (DMS) and Design Thinking Skills (DTS) scores shows that data collection is consistent and unbiased so that it can be continued for hypothesis testing.

Levene for Equality of Variance is conducted to assess the variance between the experimental and a control group is homogeneous. This test is very important to determine whether the data is analyzed with parametric statistics such as MANOVA. The results of the Levene Test are presented in Table 5.

Table 5. Levene's Test of Homogeneity of Variances

Variable	Levene Statistic	df1	df2	Sig.
Decision-Making Skills (DMS)	1.385	1	118	0.241
Design Thinking Skills (DTS)	1.214	1	118	0.289

The data analysis presented in table 4 shows the significance value for decision-making skills and design thinking skills is greater than 0.05 (Sig. > 0.05) so that the data is homogeneous. This concludes that the same variance has been met so that further parametric statistical analysis can be carried out.

Hypothesis Test

In testing the effect of the transformative multicultural learning approach on students' Decision-Making Skills (DMS) and Design Thinking Skills (DTS), a Multivariate Analysis of Variance (MANOVA) test was conducted. This test was chosen because of two dependent variables and one independent variable. In addition, this study also conducted univariate analysis to determine the individual effects of the treatment of each dependent variable. The MANOVA test was conducted to determine whether there was a significant difference between the experimental group (Multicultural-Transformative Learning Model) and the control group (Conventional Learning Model) in both dependent variables. The results of the hypothesis test are presented in Table 6.

Table 6. Results of MANOVA Hypothesis Test

Effect	Value	F	Hypothesis df	Error df	Sig.
Intercept	Pillai's Trace	0.984	2456.327b	2.000	118.000
	Wilks' Lambda	0.016	2456.327b	2.000	118.000
	Hotelling's Trace	61.745	2456.327b	2.000	118.000
	Roy's Largest Root	61.745	2456.327b	2.000	118.000
Group (Learning Model)	Pillai's Trace	0.392	24.673b	2.000	118.000
	Wilks' Lambda	0.608	24.673b	2.000	118.000
	Hotelling's Trace	0.647	24.673b	2.000	118.000
	Roy's Largest Root	0.647	24.673b	2.000	118.000

Note: $p < 0.05$ indicates statistical significance.

Based on Table 6, the results of the Multivariate Tests indicate that the learning model (Multicultural-Transformative Learning vs. Conventional Learning) has a statistically significant effect on the combined dependent variables (Decision-Making Skills and Design Thinking Skills), as evidenced by the Wilks' Lambda value of 0.608, with an F-value of 24.673 and a significance level of $p = 0.000$. This means that the implementation of the Multicultural-Transformative Learning Model significantly enhances both students' Decision-Making Skills (DMS) and Design Thinking Skills (DTS) compared to the conventional learning model.

To determine the effect of the Multicultural-Transformative Learning Model on students' Decision-Making Skills (DMS) and Design Thinking Skills (DTS), a partial test (univariate analysis) was conducted. The results of the Tests of Between-Subjects Effects are presented in Table 7.

Table 7. Partial Test Results

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	Decision-Making Skills	28.543a	1	28.543	21.387	0.000
	Design Thinking Skills	32.876b	1	32.876	26.129	0.000
Intercept	Decision-Making Skills	4789.214	1	4789.214	3585.762	0.000
	Design Thinking Skills	5123.765	1	5123.765	3954.431	0.000
Group (Learning Model)	Decision-Making Skills	28.543	1	28.543	21.387	0.000
	Design Thinking Skills	32.876	1	32.876	26.129	0.000
Error	Decision-Making Skills	103.214	118	1.148		
	Design Thinking Skills	97.654	118	1.278		
Total	Decision-Making Skills	4921.971	120			
	Design Thinking Skills	5254.432	120			
Corrected Total	Decision-Making Skills	131.757	119			

Note:
a. R Squared = 0.217 (Adjusted R Squared = 0.206)
b. R Squared = 0.252 (Adjusted R Squared = 0.241)

Based on Table 6, the results of the Tests of Between-Subjects Effects indicate that the learning model (Multicultural-Transformative Learning Model vs. Conventional Learning Model) has a statistically significant effect on both Decision-Making Skills ($F = 21.387$, $p = 0.000$) and Design Thinking Skills ($F = 26.129$, $p = 0.000$). These findings suggest that the Multicultural-Transformative Learning Model effectively enhances both competencies in students. The effect on Design Thinking Skills (25.2%) is slightly stronger than the effect on Decision-Making Skills (21.7%), indicating that the transformative and multicultural aspects of the learning model encourage more creative problem-solving and structured decision-making.

The results of the data analysis show that the transformative multicultural education approach has a positive impact on the decision-making skills and design thinking of Industrial Design Engineering students in Bali. This is due to several factors. First, the transformative multicultural education approach can improve the decision-making of industrial engineering students in Bali. The transformative

multicultural education approach can encourage students to explore and appreciate cultural diversity in the context of an interconnected industrial world. The sentence certainly makes decision-making require a thorough understanding of the industrial context with various different cultural backgrounds. By understanding the diverse cultural backgrounds, students are able to make more inclusive choices (Pasek Suryawan et al., 2022; Sariyatun & Marpelina, 2023; Syahrul et al., 2025).

Transformative multiculturalism focuses more on developing awareness of diversity so that it can help students in solving complex problems in design (Irawati & Winario, 2020; Rohman, 2023). In learning activities, students will of course be taught how to understand and integrate various cultural perspectives into the design process so that it will contribute to effective decision making (Arsyillah & Muhid, 2020; Karácsony et al., 2022; Yulianti & Awingan, 2024). For example, cross-cultural collaboration on a design project can give students practice in considering decisions in creating a good design (Halpern & Aydın, 2020). When students are fully engaged in design-based projects that emphasize multicultural contexts, they can develop better creative thinking skills. Direct experience with diverse cultural backgrounds can make students understand different perspectives and learn to create innovative solutions that are appropriate to the context (Balaba, 2023; Sanabria et al., 2022).

Second, the transformative multicultural education approach can improve design thinking skills in industrial design engineering students in Bali. The transformative multicultural approach equips students with the ability to understand and appreciate various cultural perspectives so that they are relevant to use in the global market (Irawati & Winario, 2020; Rohman, 2023). Students who are exposed to different cultural values and norms can develop critical and creative thinking skills to address highly complex design challenges (Hariyadi & Rodiyah, 2023; Plagman-Galvin & Gansemer-Topf, 2019). Learning activities in transformative multicultural education can encourage students to collaborate and discuss from different backgrounds (Ismawati et al., 2019; Karmini et al., 2020). Learning activities like this will certainly improve design thinking skills because students will work in diverse groups so they can respect each other and combine several ideas from various perspectives that allow students to find more innovative and effective solutions (Irawati & Winario, 2020; Rohman, 2023; Umar & Tumiwa, 2020). The transformative multicultural approach also encourages students to develop a more open attitude towards social and cultural changes that occur around them. In the context of engineering and design, this makes students learn to adapt quickly to the needs of diverse users.

Third, multicultural education can help students become adaptive in making decisions. Students who understand the social and cultural dynamics of various backgrounds will be better able to adapt to changes and challenges in the industry. The results of the study revealed that students involved in multicultural education will have better abilities in adapting based on the needs of the context of needs (Kwon, 2023; Umar & Tumiwa, 2020). Transformative multicultural education will provide a strong foundation for industrial design engineering students in enhancing decision-making and design thinking skills (Karácsony et al., 2022). Learning activities focus on understanding and appreciating cultural diversity so that students will become professionals and be able to contribute to building a more creative society in an increasingly complex industry.

Transformative multicultural education will help students understand social content such as equality that will influence how students approach design challenges. Incorporating cultural values into learning activities will also help students consider the social impact of their designs, thereby increasing social and ethical awareness (Kipnis et al., 2021). Such learning activities are certainly very important in the industrial world because they will be more responsive in dealing with sustainable and ethical issues. The limitation of this progress is that this content only examines decision-making and design thinking skills among industrial liquidation engineering students in Bali. Further research is expected to explore other variables such as problem-solving skills. The implication of the research is that transformative multicultural education will provide a strong foundation for industrial design engineering students in developing better design thinking skills. Integrating an understanding of cultural diversity and social perspectives into learning activities will make students more competent in engineering and design and will be better prepared to face challenges in the complex industrial world.

This study is the first to systematically investigate the implementation of a transformative multicultural education approach as a means to enhance Career Decision-Making Self-Efficacy (CDMSE), decision-making skills, and design thinking abilities among Industrial Design Engineering students in Bali. Unlike previous research, which examined these competencies separately or without a cultural dimension, this study integrates cultural diversity awareness directly into the learning model. The approach not only addresses technical skill gaps but also strengthens students' inclusive thinking,

adaptability, and ethical awareness, thereby creating a dual pathway for both professional and personal growth. The findings indicate that the Multicultural-Transformative Learning Model has a significant positive effect on both decision-making and design thinking skills, with a slightly greater impact on design thinking. This suggests that integrating cross-cultural perspectives into technical education can foster creativity, collaborative problem-solving, and more socially responsive design outputs. Educational institutions, especially in vocational and engineering contexts, can adopt this model to Better prepare graduates for globalized industrial environments. Enhance students' adaptability to diverse cultural and market demands. Embed ethical and sustainable considerations into engineering design processes. For policymakers, these results support the inclusion of multicultural and transformative pedagogies in national curricula to meet industry's evolving needs. This research was conducted exclusively on Industrial Design Engineering students in Bali, which may limit the generalizability of the results to other regions or disciplines. The study also focused only on decision-making and design thinking as outcome variables, without examining related skills such as problem-solving, innovation resilience, or teamwork efficacy. Furthermore, the intervention period was relatively short, so the long-term sustainability of skill improvement was not assessed.

CONCLUSION

This study concludes that the transformative multicultural education approach substantially enhances decision-making and design thinking skills among Industrial Design Engineering students in Bali, delivering superior outcomes compared to conventional teaching models. Its strength lies in integrating technical competency with cultural empathy, adaptability, and ethical awareness, enabling students to produce more innovative, inclusive, and market-relevant design solutions. The findings imply that embedding multicultural perspectives within design education not only enriches students' creative capacity but also equips them with the cross-cultural communication skills and global mindset essential for thriving in diverse professional environments. Beyond its proven effectiveness in the Balinese context, broader adoption of this approach could foster a new generation of globally competitive, culturally sensitive, and professionally agile designers who can navigate the complexities of an interconnected industrial landscape, thereby contributing to both local cultural preservation and global design innovation.

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AUTHOR CONTRIBUTIONS

The first author was responsible for conceptualization, methodology, software development, data curation, formal analysis, investigation, and writing (original draft preparation). The second author contributed to validation, writing (review and editing), and funding acquisition. The third author supported validation, resources, and visualization. The fourth author was responsible for supervision, project administration, and contributed to the review and editing process.

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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