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Interactive e-module design integrating deep learning and Tri-N to Improve elementary students' learning independence

Akbar Al Masjid[1*], Tiza Ariesta Saputri[2], Banun Havifah Cahyo Khosiyono[3], Jamiu Temitope Sulaimon[4]

[1,3] Universitas Sarjanawiyata Tamansiswa, Jl. Batikan, UH-III No.1043, Tahunan, Kec. Umbulharjo, Kota Yogyakarta, Daerah Istimewa Yogyakarta 55167, Indonesia

[2]Triharjo Elementary School, Panggeran 8, Triharjo, Kec. Sleman, Kabupaten Sleman, Daerah Istimewa Yogyakarta 55514, Indonesia

[4]University of Ilorin, 1515, P.M.B, Ilorin, Kwara, Nigeria

*Correspondence: ✉ almasjida@ustjogja.ac.id

ABSTRACT

Background: The level of learning independence among elementary school students is still relatively inadequate. One contributing factor is the insufficient utilization of interactive digital learning media in classroom instruction. Learning activities are predominantly carried out using traditional approaches, which tend to limit students' opportunities to actively construct knowledge and learn autonomously. Therefore, there is a clear need to introduce innovative digital learning tools that can effectively promote students' independent learning abilities.

Purpose: This study seeks to design and produce an interactive e-module for Indonesian language learning that applies a deep learning approach integrated with the Tri-N philosophy, with the aim of enhancing students' learning independence.

Method: This study employed a Research and Development (R&D) methodology utilizing the ADDIE framework, which includes the stages of analysis, design, development, implementation, and evaluation. The data collection techniques for this research use interview, questionnaire and observation techniques. The participants of this study were elementary school students involved in both limited-scale and wider-scale implementation trials. The data analysis technique uses qualitative and quantitative descriptive with N-Gain Score and T-test.

Findings: The results revealed that the developed e-module met the criteria of validity, practicality, and effectiveness. Expert validation yielded an average score of 91.5% (very feasible), while teacher and student responses reached 93.2% and 92.4% respectively, indicating excellent practicality. Furthermore, students' learning independence increased by 21.6%, supported by higher engagement and motivation during the learning process. The integration of deep learning dimensions—mindful, meaningful, and joyful learning—combined with Tri-N stages effectively enhanced students' reflective thinking and creative expression in understanding figurative language. The research concludes that this e-module serves as an innovative and culturally grounded digital learning resource aligned with the Merdeka Belajar curriculum, supporting the development of autonomous and creative learners in Indonesian elementary education.

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INTRODUCTION

The swift evolution of digital technologies has markedly transformed the field of education, particularly in terms of how digital instructional materials are developed and applied in teaching and learning processes. Digital learning resources have become increasingly important in supporting student-centered learning and facilitating independent learning processes. One form of digital learning material that is widely used in educational settings is the electronic module (e-module). An e-module is a digital version of a conventional learning module that is systematically designed to support independent learning through the integration of instructional components such as learning objectives, content explanations, exercises, feedback, and evaluation (Direktorat Pembinaan SMA, 2017). In addition, the integration of multimedia elements such as videos, animations, audio, and interactive quizzes enables e-modules to provide richer and more engaging learning experiences for students (Wulandari et al., 2022). The use of e-modules is also aligned with the principles of student-centered learning because it encourages students to actively engage in learning activities and manage their learning processes independently (Adnyana, 2024).

Learning independence is an essential competence that needs to be developed in elementary education (Amir et al., 2024; Arifin & Tihin, 2024). Independent learners are characterized by their ability to regulate their learning activities, demonstrate initiative, and take responsibility for their own learning outcomes (Oates, 2019). However, in many elementary school learning environments, students still exhibit relatively low levels of learning independence (Dignath & Büttner, 2018). Learning activities are often dominated by teacher-centered approaches, where students rely heavily on teachers to explain learning materials and guide learning tasks. Consequently, students are more likely to act as passive receivers of information rather than engaging actively in the learning process (Ramadani et al., 2025). This condition indicates the need for innovative learning strategies and digital learning resources that can encourage students to develop their learning autonomy.

Preliminary observations conducted in elementary schools revealed that the level of students' learning independence is still relatively low. Observations conducted in September 2025 at SD Negeri Jetisjogopaten and SD Negeri Triharjo involving 52 students showed that the average score of students' learning independence only reached 41.90%. The lowest score was found in the indicator of students' initiative and ability to work independently,

which only reached 33.33%, while the indicator of confidence, resilience, and adaptability reached 40.00%. These findings indicate that many students still depend heavily on teacher guidance during the learning process and have not fully developed the ability to learn independently. Therefore, it is necessary to develop innovative learning media that can support students in becoming more autonomous learners (Ramadani et al., 2025; Rosbina et al., 2025).

One of the promising approaches to address this issue is the integration of deep learning principles into digital learning materials. In educational settings, deep learning is understood as a process that prioritizes meaningful comprehension, reflective thinking, and the capacity to transfer knowledge across different contexts. It promotes students' ability to relate new information to their prior knowledge and to build deeper understanding through active involvement in learning activities (Nafi'ah & Faruq, 2025). Furthermore, deep learning involves the integration of cognitive, emotional, and social dimensions in the learning process so that students are able to develop deeper conceptual understanding rather than merely memorizing information (Mulyani et al., 2025). The application of deep learning in language learning is particularly relevant because it helps students interpret linguistic meanings, understand contextual language use, and develop critical thinking skills in analyzing texts (Apriliani et al., 2025). The integration of deep/deep meaningful learning principles in the e-module not only enriches the content of the material, but also changes the way students learn: from simply receiving information to being reflective and applicative independent learners (Rui et al., 2024). Various cross-year and contextual studies show that when digital design adopts deep learning principles, students' independence, motivation, and conceptual understanding increase markedly (Kharroubi & ElMediouni, 2024; Zhai & Nezakatgoo, 2025).

In educational practice, the deep learning approach is typically applied through three core principles: mindful learning, meaningful learning, and joyful learning (Andayanie et al., 2025; Feriyanto et al., 2024). Mindful learning highlights students' awareness of their own learning processes and fosters reflection on both the content and the strategies they use (Mahrunnisya, 2025). Meaningful learning emphasizes the integration of new knowledge with learners' prior understanding and real-life contexts (Alim et al., 2025; Ricita et al., 2025). Meanwhile, joyful learning is directed toward creating an engaging and enjoyable learning atmosphere that encourages students to actively participate in learning activities (Hikmawati et al., 2024; Pusat Kurikulum dan Pembelajaran, 2025). These three principles collectively contribute to the development of reflective, contextual, and emotionally engaging learning experiences that support students' learning independence.

In addition to modern educational approaches, Ki Hajar Dewantara's concept of thinking also provides valuable pedagogical foundations for meaningful learning. One of

the prominent educational concepts introduced by Ki Hadjar Dewantara is the Tri-N learning principle, which consists of niteni, nirokke, and nambahi. The concept of Tri-N describes a natural learning process in which students first observe phenomena or examples (niteni), then imitate or practice what they have observed (nirokke), and finally develop new ideas or innovations based on their understanding (nambahi) (Nafisah et al., 2024). This concept reflects a constructivist learning process in which knowledge is gradually constructed through meaningful learning experiences (Wijayanti et al., 2025). Moreover, the Tri-N principle also reflects the philosophical values of Tamansiswa education, which emphasize the development of students' intellectual, emotional, and moral capacities through active participation in learning activities (Herdeta et al., 2025).

The integration of deep learning and the Tri-N learning philosophy has the potential to create meaningful, reflective, and contextual learning experiences for students. In the context of Indonesian language learning in elementary schools, this integration is particularly relevant because language learning requires not only cognitive understanding but also creativity, interpretation, and contextual communication skills (Mulyani et al., 2025; Rochim et al., 2025). Through the stages of observing, imitating, and developing ideas, students are expected to build deeper conceptual understanding while simultaneously developing their creativity and learning independence. Therefore, integrating the deep learning approach with the Tri-N learning philosophy in digital learning materials may provide an effective strategy to improve students' learning experiences (Srirahayu et al., 2023). Deep learning in Indonesian emphasizes meaningful, reflective, and relevant understanding of real experiences, as well as increasing student engagement and self-awareness (Rochim et al., 2025).

Several previous studies have explored the development of e-modules and the implementation of deep learning approaches in the context of basic education. Research by Wijayanti et al. (2025) shows that deep learning-based e-modules can effectively improve students' language literacy skills. Other research shows that digital learning media such as e-modules can significantly improve students' learning outcomes, motivation, and independence with effectiveness rates ranging from 85% to 95% (Arrahmi et al., 2024; Inayati, 2024; Rahayu, 2024). In addition, research by Dewi & Lestari, (2020) reported that the use of digital learning media can significantly improve student motivation and learning outcomes. He added that research by Adnyana (2024) showed that the implementation of deep learning in Indonesian language learning increased students' text comprehension by 23% and reflective learning ability by 17%. Similarly, research conducted by Habsia et al. (2025) found that students who learn through e-learning platforms show higher learning independence compared to those who use conventional learning methods. Similarly, research conducted by Hikmawati et al.,(2024) found that the application of deep learning-

based learning significantly improves students' critical thinking skills and learning independence. However, most of these studies mainly focus on learning outcomes or motivation and have not integrated the Concept of the Teachings of Tamansiswa from Ki Hajar Dewantara with the concept of Tri-N into digital learning materials.

Although previous studies have reported encouraging results, several gaps in the literature can still be identified. First, many investigations have emphasized the effectiveness of digital learning media in enhancing learning outcomes; however, the integration of deep learning principles into the design of instructional materials has not been comprehensively addressed. Second, the incorporation of local educational philosophies, such as the Tri-N concept, into digital learning media remains relatively underexplored. Third, there is still a lack of research that simultaneously integrates the deep learning approach and the Tri-N philosophy in the development of interactive e-modules for Indonesian language instruction at the elementary school level. Therefore, further studies are necessary to examine how the combination of deep learning and the Tri-N philosophy can be utilized to strengthen students' learning independence through interactive digital learning resources.

Based on these considerations, this study is designed to develop an interactive Indonesian language e-module that incorporates a deep learning approach integrated with the Tri-N learning principles to enhance elementary school students' learning independence. The proposed e-module is expected to serve as an innovative digital learning resource that facilitates meaningful, reflective, and engaging learning experiences. Furthermore, this study aims to contribute to the advancement of culturally responsive digital learning materials by combining contemporary educational approaches with Indonesian educational philosophy.

The novelty of this research lies in the integration of three main aspects in the development of digital learning materials. First, this study integrates the deep learning approach into the design of an interactive e-module to promote meaningful and reflective learning experiences. Second, the research incorporates the Tri-N learning philosophy as a pedagogical framework that guides the learning activities in the e-module. Third, this study focuses specifically on improving elementary school students' learning independence through the integration of these two approaches. By combining these elements, the research is expected to contribute new insights into the development of innovative and culturally grounded digital learning media in elementary education. Based on the objectives of the study, the research hypothesis proposed is that the interactive Indonesian language e-module based on deep learning integrated with the Tri-N principle is valid, practical, and effective in improving elementary school students' learning independence.

METHODS

This research applies the Research and Development (R&D) method with the aim of producing products that have a high level of validity, practicality, and effectiveness in learning. The development model used in this study is the ADDIE model proposed by Branch & Varank (2009). This model includes five main stages, namely Analysis, Design, Development, Implementation, Evaluation. The selection of the ADDIE model is based on the consideration that this model is easy to apply, systematic, flexible, and based on learning design theory. In addition, ADDIE's advantage lies in its ability to return to the previous stage if weaknesses or inconsistencies are found, allowing for continuous improvement (Adeoye et al., 2024). The design process with the ADDIE model is carried out systematically and structured to answer problems in learning, especially related to the development of learning materials that are in accordance with the characteristics, conditions, and needs of students (Muspirad et al., 2025).

This research is development research that focuses on the development of Indonesian language learning modules with majas materials. The product developed is an interactive Indonesian e-module based on Tri-N integrated deep learning. The main goal of this research is to produce a decent, practical, and effective learning product. This research contributes to the development of innovative and relevant teaching materials that are not only in harmony with the curriculum but also support the improvement of student competencies through more independent, adaptive, and technology-based learning.

The design of the product development trial is carried out through two stages, namely a limited trial and a broad trial. These two trials were carried out to assess the feasibility, effectiveness, and practicality of the interactive Indonesian e-module based on Tri-N integrated deep learning in increasing student learning independence. The limited trial was carried out at Jetisjogopaten Elementary School with a subject of 10 grade V students, and a wide trial was carried out on 42 grade V students of Triharjo Elementary School. The selection of this subject is based on the suitability of students' characteristics with the needs of the development of Tri-N's integrated deep learning-based e-modules. Both schools were chosen because they had representative learning conditions to measure the effectiveness of the product empirically.

The data collection techniques used in this study included interviews, observations, and questionnaires. The data collection instruments used by the researcher were interview guides, observation sheets on the independence dimension, validation sheets for e-module products, and questionnaires for student and teacher responses.

Data analysis techniques use qualitative and quantitative descriptive using feasibility analysis, practicality tests, student and teacher responses, and effectiveness tests. Observations obtained from observations of students' learning independence were

analyzed using the Likert scale as a reference for assessment and qualification. The Likert scale is modified into four categories of assessments, so that respondents or observers give a more assertive assessment without choosing a neutral position. Each category is given a score, namely 4 for highly developed, 3 for developing as expected, 2 for developing, and 1 for starting to develop. Furthermore, the results of the observations were calculated to obtain an average score (mean) using the following formula.

$$P = \frac{\sum X}{X_{\max}} \times 100\%$$

Description:

P = Percentage score

$\sum X$ = Total score obtained

$X_{\max}$ = Maximum possible score

Table 1

Learning Independence Qualification Guidelines

Interval Persentase	Kriteria
Skor ≥ 80%	Highly independen
75% ≤ Skor ≤ 79,9%	Self-Sufficient
70% ≤ Skor ≤ 74,9%	Quite self-sufficient
60% ≤ Skor ≤ 69,9%	Less independent
Skor ≤ 59,9%	Very less independent

source: Danuri, Maisaroh, & Prosa (2019).

Table 2

Validity Level Criteria

Persentase Skor Kevalidan	Kriteria
81 ≤ N < 100%	Highly Valid
61 ≤ N < 81%	Valid
41 ≤ N < 61%	Quite Valid
21 ≤ N < 41%	Less Valid
0 ≤ N < 21%	Invalid

The effectiveness analysis aims to find out the extent to which Tri-N's integrated *deep learning-based e-modules* are able to increase the learning independence of elementary school students. The effectiveness of the product was measured using a comparison of the results of observations of students' learning independence levels before (*pretest*) and after (*posttest*) the implementation of e-modules in two trial stages. The analysis is carried out

quantitatively through stages, including the analysis prerequisite test, *independent sample t-test*. The basic formula of *the Independent Sample t-test* according to Sudjana (2005) is as follows.

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{(n_1-1)s_1^2+(n_2-1)s_2^2}{n_1+n_2-2}\left(\frac{1}{n_1}+\frac{1}{n_2}\right)}}$$

Before the data is analyzed, a prerequisite test is analyzed before testing the effectiveness with an independent sample t-test, a prerequisite test is carried out first to ensure that the data meets the assumptions in parametric statistics. The types of prerequisite tests used include normality tests and homogeneity tests.

Analysis of score improvement using normalized gain (N-gain) calculation The N-Gain formula used refers to (Hake, 1998; Yani et al., 2021).

$$g = \frac{Spost - Spre}{Smaks - Spre}$$

RESULT AND DISCUSSION

Results

Development of the Interactive E-Module

The development of the interactive Indonesian language e-module in this study followed the ADDIE development model, which consists of five stages: analysis, design, development, implementation, and evaluation.

Needs Analysis of Learning Independence

The analysis stage focused on identifying learning problems and students' needs in Indonesian language learning at the elementary school level. Preliminary observations revealed that students' learning independence was relatively low, as indicated by the average score of learning independence which only reached 41.90%. The lowest score was found in the indicator related to students' initiative in completing learning tasks independently (33.33%). These findings indicate that students still rely heavily on teacher guidance during the learning process.

Instructional Design of the E-Module

Based on these findings, the researcher designed an interactive e-module that integrates the deep learning approach and the Tri-N learning principle (*niteni*, *nirokke*, and *nambahi*). The learning activities in the module were designed to support mindful learning, meaningful learning, and joyful learning experiences for students. The e-module was developed using digital platforms such as Canva and Liveworksheet, which allowed the integration of multimedia components including images, videos, and interactive exercises.

These components were designed to enhance students' engagement and support independent learning processes.

The structure of the developed e-module consisted of several main components, including learning objectives, concept explanations, examples of figurative language (*majas*), interactive exercises, and evaluation activities. The learning materials focused on Indonesian language topics related to figurative expressions such as metaphor, personification, and hyperbole. The integration of the Tri-N concept was implemented through sequential learning activities in which students first observed examples of figurative language (*niteni*), then practiced imitating the patterns of figurative expressions (*nirokke*), and finally developed their own creative expressions (*nambahi*). This learning structure was designed to encourage students to actively engage in the learning process and develop deeper conceptual understanding of the learning materials (Nafisah et al., 2024).

Product Validation

Before being implemented in classroom learning, the developed e-module underwent a validation process conducted by experts to determine its feasibility as a learning medium. The validation process involved two experts, namely a material expert and a learning media expert. The assessment focused on several aspects, including the relevance of the learning content, the clarity of explanations, the quality of visual design, the suitability of learning activities, and the integration of the deep learning approach. The results of the expert validation are presented in Table 3.

Tabel 3.
Product Validation Results

Validator	Assessment Percentage	Category
Material Expert	95.71%	Very Feasible
Learning Media Expert	94.00%	Very Feasible

The evaluation results indicate that the developed e-module meets a very high feasibility standard as determined by expert judgments. The material expert evaluation showed a score of 95.71%, indicating that the learning materials presented in the e-module were highly relevant to the curriculum and learning objectives. Meanwhile, the learning media expert provided a score of 94.00%, indicating that the design, layout, and multimedia integration of the e-module were considered very appropriate for elementary school learning contexts.

This finding suggests that the developed e-module can be considered both valid and feasible for use as a digital learning resource. Similar findings have been reported in previous studies showing that interactive e-modules can effectively support independent learning when they are designed with appropriate instructional structures and multimedia

integration (Arrahmi et al., 2024; Inayati, 2024). The integration of pedagogical principles and interactive features within digital modules can enhance student engagement and promote deeper understanding of the learning material.

Practicality of the E-Module

After the validation process, the developed e-module was implemented in classroom learning to evaluate its practicality. Practicality testing was conducted by engaging teachers as practitioners to evaluate how the e-module functions in real learning contexts. The assessment emphasized factors such as user-friendliness, clarity of guidance, relevance of learning activities, and students' engagement. The results of the practicality test are presented in Table 4.

Tabel 4.
Practically Test Results

Assessed Aspect	Percentage	Category
Ease of Use	93.75%	Very Practical
Clarity of Learning Instruction	95.00%	Very Practical
Learning Activity Suitability	94.00%	Very Practical
Student Engagement	95.97%	Very Practical

The results indicate that the developed e-module is categorized as very practical for use in classroom learning. Teachers reported that the e-module was easy to use and provided clear learning instructions that facilitated students' understanding of the learning materials. The interactive features of the e-module were considered effective in increasing students' participation during learning activities. These findings support previous research indicating that interactive digital learning media can improve student engagement and facilitate independent learning processes. According to Maharani et al. (2022), the use of interactive e-modules can increase students' motivation and encourage them to explore learning materials more actively.

Impelementation & Evaluation

Effectiveness Test

The effectiveness of the developed e-module was evaluated through limited and large-scale trials involving elementary school students. The effectiveness test aimed to examine whether the use of the e-module could improve students' learning independence. The results of the N-Gain analysis are presented in Table 5.

Tabel 5.
N-Gain Test Results

Trial Stage	N-Gain Score	Category
Limited Trial	0.764	High
Large-scale Trial	0.874	High

The findings indicate that the implementation of the interactive e-module led to a significant improvement in students' learning independence. In the limited trial, the N-Gain score reached 0.764, which is categorized as a high level of improvement. This value further increased to 0.874 in the large-scale trial, reflecting a very high level of enhancement in students' learning independence after using the e-module.

To examine the statistical significance of this improvement, a paired sample t-test was performed to compare students' pretest and post-test scores. The analysis yielded a significance value of 0.000 ($p < 0.05$), demonstrating that the increase in students' learning independence following the use of the e-module was statistically significant. These results confirm that the developed e-module is effective in fostering students' independent learning.

Discussion

The findings of this study demonstrate that the interactive Indonesian language e-module based on the deep learning approach integrated with the Tri-N learning principle is valid, practical, and effective in improving elementary school students' learning independence. The high validation scores obtained from expert evaluations indicate that the developed learning media meets the standards of instructional design and content relevance. The integration of multimedia elements, interactive exercises, and structured learning activities contributes to the overall quality of the learning media.

The improvement in students' learning independence observed in this study can be explained through the principles of deep learning implemented in the e-module. Deep learning emphasizes meaningful understanding, reflective thinking, and the application of knowledge in authentic contexts (Nafi'ah & Faruq, 2025). Through learning activities that encourage observation, practice, and creative development of ideas, students are able to construct deeper conceptual understanding and become more actively involved in the learning process.

The integration of the Tri-N learning principle also plays a significant role in supporting students' independent learning. The stages of *niteni, nirokke, and nambahi* provide a structured learning pathway that encourages students to observe learning phenomena, practice learned concepts and develop their own creative expressions. This process aligns with constructivist learning theory, which emphasizes that knowledge is constructed through active learning experiences (S. Wijayanti & Mizan, 2021).

Furthermore, the use of interactive digital learning media allows students to explore learning materials independently and at their own pace. The flexibility offered by e-modules enables students to review learning materials repeatedly and complete learning activities

without depending entirely on teacher explanations. This learning environment encourages students to develop responsibility and initiative in managing their own learning processes.

The findings of this study are consistent with previous research showing that digital learning media can significantly improve students' learning outcomes, motivation, and learning independence (Arrahmi et al., 2025; Inayati, 2024; Rahayu, 2024). However, this study offers a novel contribution by integrating the deep learning approach with the Tri-N learning philosophy in the development of an interactive e-module for Indonesian language learning. This integration provides a culturally relevant learning model that combines modern educational approaches with Indonesian educational values. The results of this study indicate that the integration of deep learning and the Tri-N learning principle can create meaningful learning experiences that support students' cognitive, emotional, and creative development simultaneously. By engaging students in reflective and creative learning activities, the developed e-module not only improves students' learning independence but also encourages them to develop higher-order thinking skills and creativity in language learning contexts.

CONCLUSION

This study concludes that the interactive Indonesian language e-module developed using a deep learning approach integrated with the Tri-N principles is valid, practical, and effective in enhancing elementary school students' learning independence. The integration of deep learning principles—mindful learning, meaningful learning, and joyful learning—within the Tri-N learning stages (*niteni, nirokke, and nambahi*) creates a structured and meaningful learning process that encourages students to actively observe, imitate, and develop their understanding of learning materials. The results demonstrate that the developed e-module facilitates independent learning by enabling students to explore learning resources autonomously, engage in reflective learning activities, and construct deeper conceptual understanding through interactive and contextual learning experiences. These findings confirm the research hypothesis that the use of an interactive e-module integrating deep learning and Tri-N principles significantly enhances students' learning independence.

Additionally, this research provides a contribution to the development of innovative digital learning resources through the integration of modern pedagogical approaches and Indonesian educational philosophy. The combination of deep learning and the Tri-N concept provides a culturally relevant pedagogical framework that supports meaningful learning and promotes students' cognitive, emotional, and creative development. Therefore, the developed e-module not only functions as a digital learning resource but also serves as

an instructional model that integrates technology, pedagogy, and local educational values in elementary education.

Suggestions for future research and educational practice include the wider implementation of the developed e-module in various educational contexts to examine its effectiveness across different subjects and grade levels. Teachers are encouraged to integrate interactive digital learning media that combine modern learning approaches with local educational philosophies in order to promote students' learning independence and meaningful learning experiences. Furthermore, future researchers may develop similar digital learning resources by integrating other innovative learning approaches and educational values to enrich the development of culturally responsive digital learning materials in elementary education.

DECLARATIONS

Author Contribution

Al Masjid, **A**., Conceptualization, Writing – Original Draft, Editing, and Finalization; **Saputri**, **T. A.,** Data Collection, Data Organization, and Data Analysis; **Khosiyono, B. H. C.,** Translation; **Sulaimon, J. T.,** Translation and Proofreading.

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Conflict of Interest

The authors declare no conflict of interest.

Declaration of AI Use

ChatGPT was utilized to enhance language clarity under the supervision and control of the authors.

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