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Development of a phase f physical education textbook based on the merdeka curriculum using the addie model

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ABSTRACT

Background. The main problem in this study is the lack of adequate Physical Education (PE) teaching materials for Phase F that are aligned with the Merdeka Curriculum learning outcomes. This limitation results in learning that is not student-centered, and teachers struggle to provide independent guidance that is appropriate for the school's available facilities and infrastructure. **Objectives.** The objective of this study is to develop valid, practical, and effective Phase F Physical Education teaching materials for the Merdeka Curriculum at State Senior High School 4 Malang. **Method.** This study employed the R&D model based on the Analysis, Design, Develop, Implement, Evaluate (ADDIE) framework. Data collection involved direct observation, interviews, and questionnaires, utilizing both qualitative and quantitative data analysis techniques. **Results.** Validation results from subject matter experts yielded a score of 92% and from media experts, 94%, indicating that the textbook is highly valid in terms of content, presentation, and visual design. Additionally, the small-group pilot test yielded a percentage of 83.8% (categorized as "highly suitable/practical"), and the large-group pilot test yielded 88.2% (categorized as "highly suitable/effective"). **Conclusion.** Based on these results, it can be concluded that the Physical Education textbook is highly suitable, practical, and effective for use in learning activities. This textbook, which contains four chapters of content, visual images, integrated QR codes, and Student Activity Sheets (SAS), makes a significant contribution to facilitating differentiated learning and supporting students' independence in movement literacy in accordance with the philosophy of modern physical education.

Key words: Textbook; basketball; badminton; javelin throw; physical fitness.

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INTRODUCTION

The development of the Merdeka Curriculum in Indonesia has brought about various changes, particularly in the field of education. The Merdeka Curriculum is one of the government's efforts to grant autonomy to educators to achieve high-quality learning that aligns with students' needs and learning conditions (Ockta & Mardesia, 2023). The Merdeka Curriculum enables educators to implement a contextual curriculum tailored to students' needs. It is hoped that the Merdeka Curriculum will transform the learning process from a traditional system to a student-centered approach. This enables students to strengthen their skills and character in line with their values. Teachers can design differentiated instruction tailored to students' characteristics and diversity (Indriani wt al., 2021; Naylor & Yeager, 2013; Suherman et al., 2019).

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In Physical Education (PE), flexible learning outcomes for each phase and class period will create a comfortable learning experience that aligns with students' needs (Athaya et al., 2023; Ebrahim & Hussein, 2025; Yusroni, 2024). To support this, instructional materials are required. Instructional materials are tools that can support teaching methods. These include print and audiovisual media. Textbooks are a form of instructional material in PE. Materials that assist teachers in instructing students—which must be utilized and updated to supplement or enrich literacy in physical education—are referred to as instructional materials (Amini, 2020). With the availability of textbooks, it is hoped that students can actively develop their skills according to their abilities (Martinez-Bello & Molina-García, 2016). Additionally, this provides educators with flexibility in designing instructional materials, ensuring that learning takes individual differences into account rather than being based solely on the teacher's preferences. With the availability of teaching materials, it is hoped that learning can be optimized because students are aware of the competencies or progress at each stage, which can aid the learning process and foster active, student-centered learning (Li, 2015; Makaruk et al., 2023; Tanır & Erkut, 2018; Zhang et al., 2024). The development of textbooks plays a crucial role in teacher professional development and educational reform. Furthermore, textbooks can serve as a means of transferring knowledge to students.

According to the 2018 PISA survey, students in Indonesia are very weak in literacy, numeracy, and knowledge (McComas, 2014). PE is an integral part of the learning process, aimed at improving an individual's abilities through the use of selected physical activities (Bucher, 1983). Learning is a process of personality or skill development that can be reinforced within a limited timeframe and does not stem from a progressive procedure (Winarno, 2008). Physical education provides students with the opportunity to learn movement (psychomotor skills), as they move in order to learn (Hariyoko, 2003). Meanwhile, the phases of motor learning consist of the cognitive stage, the associative stage, and the autonomous stage (Arsil et al., 2024; Setiawan et al., 2020; Suryadi etal, 2025; Suryadi et al., 2024; Umar et al., 2023). Therefore, in the implementation of PE, its objectives should be applied so that brain growth and development can occur optimally (Saichudin, 2014). According to the learning outcomes in the Merdeka Curriculum, the objective of PE is to facilitate students in discovering active movement and achieving physical fitness.

Textbooks are essential resources for PE instruction. In developing textbooks, it is necessary to consider students' characteristics and their current needs (Setiawan & Ahla, 2023). Textbooks are a medium that can support learning because they enable students to learn independently, and they serve as a crucial supporting factor in physical education instruction. Students' low conceptual understanding is also attributed to the lack of textbooks tailored to

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their characteristics, resulting in students failing to achieve mastery at the class level (Ramadoni et al., 2019). Media serve as a tool for transferring information from teachers to students; thus, the use of such media is expected to create a conducive and optimal learning environment (Arif et al., 2023). Previous research has shown that the development of textbooks can improve the quality of science education (Sari et al., 2019). Textbooks are a medium that can engage students in active, individual practice. Modules can be used in all institutions and are cost-effective (Schoenherr et al., 2022). Although the Merdeka Curriculum emphasizes independence and differentiated learning, a gap identified in the field indicates that the demand to improve students' motor literacy and fitness achievements in accordance with national standards is not yet aligned with the availability of adaptive learning guidelines. Most existing teaching materials still focus on traditional, teacher-centered learning approaches and pure sports disciplines, and do not yet accommodate the specific needs of students in Phase F, which demands independence and the integration of technology. Previous studies have demonstrated that physical education instructional materials can improve students' learning experiences and support curriculum implementation. Other studies have also integrated digital learning resources and innovative teaching strategies into physical education. Despite the growing number of studies on physical education instructional materials, few have developed Phase F textbooks integrating movement literacy, differentiated learning, QR-based learning resources, and student logbooks within the Merdeka Curriculum framework. Therefore, there remains a need to develop a comprehensive textbook that accommodates these components to better support the implementation of the Merdeka Curriculum in senior high schools.

Active learning is essential for students because it allows teachers to explore students' prior concepts and ideas (Cho & Clary, 2020). According to Dwiyogo (2008), instructional media are designed to motivate students to enhance their individual abilities; students undergo this process during learning activities. One crucial step in improving educational quality is developing innovative textbooks (Ding et al., 2023; Kamahina et al., 2019; Martinez-Bello & Molina-García, 2016). Textbooks are essential for meeting students' learning needs. This aligns with the function of textbooks in fostering student independence (Sulistiyono, 2022). Textbooks serve as a tool to support the learning process. The development of textbooks requires validation by media experts and PE subject matter experts. The researcher's initial observations revealed that Phase F PE textbooks are not yet available at State Senior High School 4 Malang.

This situation highlights the problem of the unavailability of Phase F PE, Sports, and Health teaching materials specifically designed to support self-directed learning based on technological advancements and the characteristics of high school students. State Senior High School 4 Malang has 10 classes for

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11th grade, with a total of 352 students. There is a shortage of textbooks. This research aims to develop a valid, practical, and effective Phase F PE textbook for the Merdeka Curriculum at State Senior High School 4 Malang, with content aligned with the school's existing facilities and infrastructure. Therefore, this study seeks to create a valid, practical, and effective Phase F PE textbook for the Merdeka Curriculum at State Senior High School 4 Malang. This study develops lies not only in adapting the content to local facilities and infrastructure but also in the development of a prototype for an interactive textbook that integrates movement literacy guidelines, a logbook for independent activities, and the structured use of QR codes. This novelty has strategic national implications as a reference model for PE and Health instructional materials in the digital age that educate students to be physically fit. A key contribution of this research is providing a framework for practical instructional materials that can be widely adopted by teachers and schools to achieve the goals of modern PE—namely, fostering a generation that is physically literate, fit, independent, and competitive.

METHOD

Participant

The research subjects were 11th-grade students in classes IPA3, IPA4, IPA5, and IPS1. For the small-group pilot test, there were 10 respondents from 11th-grade class IPA3, while for the large-group pilot test, there were 30 respondents from 11th-grade classes IPA4, IPA5, and IPS1.

Research Design

This study employed the Research and Development (R&D) method using the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation) proposed by Lee and Owens. This method is widely used in development research because it provides a systematic and structured framework. This research aims to develop a textbook suitable for use in the learning process. The stages of the ADDIE model include: (a) analysis, which is the first stage before creating the product and involves analyzing learning outcomes and student needs; (b) design, which includes planning the content, designing the textbook, and planning research instruments; (c) development, which consists of two stages: producing/refining instructional materials and validating high-quality textbooks to be used to achieve the objectives; (d) implementation, which involves preparing a conducive learning environment by directly engaging students; and (e) evaluation, which is the final step to provide feedback on the suitability of the textbooks. The purpose of this evaluation is to provide feedback on the development of textbooks for instruction. The

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evaluation was conducted by experts and involved small-group and large-group pilot tests.

The design stages were: (a) evaluation by subject matter and media experts; (b) a small-group pilot test with 10 participants; and (c) a large-group pilot test with 30 participants, including both boys and girls.

Data Analysis

The instruments used to collect data included observation, interviews, and questionnaires. These instruments yielded both qualitative and quantitative data. Qualitative data were obtained from experts' descriptions and suggestions regarding the product, while quantitative data were obtained from the small-and large-group trials. Quantitative data was measured using a Likert scale (Sugiyono, 2016). The data analysis technique used the validity percentage formula to process data for each test subject as follows:

$$P = (\Sigma x) / (\Sigma xi) \times 100\%$$

Notes:
P : validity percentage
∑x : total sum of scores for each item
∑xi : total score per item 100% : constant

Classification criteria were established to facilitate drawing conclusions from the percentage analysis as follows:

Table 1. Percentage analysis

Percentage	Category	Description
81% – 100%	Highly valid	Can be used without revision
61% – 80%	Valid	Can be used with minor
41% – 60%	Fairly valid	Revisions cannot be used
21% – 40%	Not very valid	Prohibited
0% – 20%	Invalid	

Source: (Akdon & Riduwan, 2015)

FINDINGS AND DISCUSSIONS

Findings

During the analysis phase, a significant gap was identified between the availability of formal teaching materials and the number of class groups, which could affect the quality of learning and student engagement in the PE program. The development of a Grade 11 PE textbook was undertaken to address this need, ensuring that instruction is more focused, systematic, and aligned with the learning outcomes of the Merdeka Curriculum.

After conducting the analysis, the researchers created a draft design for the textbook. Before the textbook was pilot-tested, it was validated by subject

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matter experts and media experts. The results of the subject matter expert validation showed an average score of 94% (highly valid). This indicates that the content, structure, and initial presentation of the textbook are substantively sound. Experts provided feedback such as the addition of QR codes, corrections to typographical errors, and fixes to QR links, highlighting the need to integrate digital elements into the textbook to make it more comprehensive and relevant to contemporary demands.

Subsequent small-group and large-group pilot tests yielded valid results, demonstrating that the textbook is not only valid in terms of theory and content but is also practical, usable, and well-received by both students and teachers.

The data on the textbook development results are presented as follows:

Table 2. Textbook validation results

No	Procedure for Developing	Findings
1	Needs analysis	
	a. Observation results of the implementation of physical education lessons in grade 11	It was found that 10 study groups with 352 students did not have the Grade 11 Physical Education textbook available.
	b. Questionnaire distribution	Based on the researcher's observations in the field.
	c. Interviews	Based on the researcher's observations in the field.
2	Product Development and Expert Justification (Expert Validation)	
	a. Media Expert	The average expert validation score for the content was 94%, categorized as "highly valid." Experts provided suggestions to add QR codes, correct QR codes, and fix typographical errors.
	b. Subject Matter Expert	The average expert validation score for the content was 92%, categorized as "highly valid." Suggestions included focusing the content on the theme of movement rather than specific sports disciplines; emphasizing that physical fitness in physical education, sports, and health is not merely to make children fit but to educate them to be fit; and adding Student Worksheets or a logbook to track movement or physical activity—the book can be implemented as suggested.
3	Product Effectiveness Test (small and large group tests)	The results of the small-group pilot test averaged 83.8% and were categorized as "highly valid." The results of the large-group pilot test averaged 88.2% and were categorized as "highly valid."

Expert validation is necessary to determine the validity of a test. The validation process for the development of this textbook involved two physical education subject matter experts and two media experts—one university

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professor and one ICT teacher, both holding master's degrees. This validation was used to assess whether the textbook under development was ready for pilot testing. The following are the results of the content validation for the textbook under development.

Table 3. Subject matter expert validation

No	Indicator	Score Results	Maximum Score	Percentage	Category
1	Material Coverage	211	224	94%	Very Valid
2	CP Suitability	59	64	92%	Very Valid
3	Presentation Components	114	128	89%	Very Valid
4	Language Suitability	60	64	94%	Very Valid
	Average	111	120	92%	Very Valid

Based on the subject matter experts' justification, the content coverage component scored 94% and was categorized as "highly valid"; the alignment of learning outcomes component scored 92% and was categorized as "highly valid"; the textbook presentation component scored 89% and was categorized as "highly valid"; and the language appropriateness component scored 94% and was categorized as "highly valid." The overall average for the content justification was 92%, categorized as "highly valid." In the subject matter expert's evaluation, several suggestions were made, including the use of appropriately sized images and barcodes, appropriate font selection, ensuring that the material on movement focuses on movement itself rather than its branches, and for the physical fitness material, encouraging students to stay fit and adding student worksheets.

The following are the results of the media expert's evaluation of the textbook.

Table 4. Media expert validation

No	Indicator	Score Results	Maximum Score	Percentage	Category
1	Physical	28	32	88%	Very Valid
2	Introduction	21	24	88%	Very Valid
3	Content	16	16	100%	Very Valid
4	Utilization	40	40	100%	Very Valid
5	Questions/Evaluation	23	24	96%	Very Valid
6	Attachments	22	24	92%	Very Valid
	Average	25	26.67	94%	Very Valid

Data obtained from the physical components of the textbook showed that 88% were categorized as "highly valid"; the introductory components of the

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textbook were 88% "highly valid"; the content components of the textbook were 100% "highly valid"; the textbook utilization components were 100% "highly valid"; the test/evaluation component of the textbook was 96% in the "highly valid" category, and the appendix component of the textbook was 92% in the "highly valid" category. Based on the results of the media expert's review, an average of 94% was classified as "highly valid." The media expert recommended that there be more QR codes, that their sizes be proportional, and that the questions be relevant to the material. A small-group pilot test was conducted after the design was revised by the media expert, and the material was aligned with the textbook to be developed. After the product was revised, the small-group pilot test was conducted. The results of the small-group pilot test were used to evaluate the textbook to be developed. The following table presents the results of the small-group pilot test.

Table 5. Small Group Trials

No	Indicators	Percentage	Category
1	Suitability	85.6%	Highly Appropriate
2	Ease	85.6%	Highly Appropriate
3	Interesting	80.6%	Highly Appropriate
4	Example Accuracy	81.3%	Highly Appropriate
5	Evaluation	82.5%	Highly Appropriate
6	Suitability	84.4%	Highly Appropriate
7	Measurement	80.6%	Highly Appropriate
8	Suitability	86.9%	Highly Appropriate
9	Suitability	86.3%	Highly Appropriate
	Average	83.8%	Highly Appropriate

From the small-group pilot test, the textbooks achieved an average of 83.8% in the "very suitable" category. Based on the components of instructional material content suitability, 85.6% fell into the "very suitable" category; for textbook usability, 85.6% fell into the "very suitable" category; for instructional material appeal, 80.6% fell into the "very suitable" category; for the accuracy of textbook examples, 81.3% fell into the "very suitable" category; the textbook's evaluation component was 82.5% in the "highly appropriate" category, the image suitability component was 84.4% in the "highly appropriate" category, the font size component was 80.6%, the language suitability component was 86.9% in the "highly appropriate" category, and the barcode suitability component was 86.3% in the "highly appropriate" category. Based on the results of the small-group pilot test, the average of 83.8% in the "Highly valid" category indicates high validity. These results indicate that the textbooks in the small-group pilot test are highly appropriate. The data is presented as follows:

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Table 6. Large-group pilot test

No	Indicator	Score	Maximum Score	Percentage	Category
1	Accuracy	430	480	89.6%	Highly Valid
2	Ease	416	480	86.7%	Highly Valid
3	Interest	419	480	87.3%	Highly Valid
4	Sample accuracy	424	480	88.3%	Highly Valid
5	Evaluation	424	480	88.3%	Very Valid
6	Conformity	423	480	88.1%	Highly Valid
7	Size	424	480	88.3%	Highly Valid
8	Fit	423	480	88.1%	Highly Valid
9	Fit	427	480	89.0%	Highly Valid
	Average	423.33	480	88.2%	Highly Valid

From the large-scale pilot test, the average for instructional materials was 88.2% in the "highly valid" category. Based on the textbook content appropriateness component, 89.6% was rated "highly valid"; for the textbook ease-of-use component, 86.7% was rated "highly valid"; for the textbook appeal component, 87.3% was rated "highly valid"; for the textbook example accuracy component, 88.3% was rated "highly valid"; the evaluation component scored 88.3% in the "highly valid" category; the image appropriateness component scored 88.1% in the "highly valid" category; the font size component scored 88.3% in the "highly valid" category; the language appropriateness component scored 88.1% in the "highly valid" category; and the barcode appropriateness component yielded an average of 89.0% in the "highly valid" category. Based on the results of the large-group pilot test, the average was 88.2% in the "highly valid" category. From these findings, it can be concluded that the textbooks used in the large-group pilot test are highly valid.

Discussion

The results of the development of this 11th-grade PE textbook demonstrate very high levels of validity, practicality, and effectiveness. These findings consistently reinforce previous studies affirming that the availability of structured instructional materials significantly facilitates students' understanding of the subject matter and enhances their physical competencies (Kusdianto & Sari, 2019). However, as a form of novelty, this product does not merely digitize text—as is typically the case with electronic teaching materials (Arifin et al., 2023)—but rather offers a philosophical shift. This textbook is designed to educate students so they can independently manage their physical activities to achieve fitness, which is fully aligned with the (Movement Literacy) guidelines and objectives of the Merdeka Curriculum.

The development of this textbook directly responds to the paradigm shift in PE from a conventional sports-branch approach toward strengthening movement

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literacy. Until now, many PJOK curriculum designs have focused rigidly on mastering basic techniques, which risks marginalizing students without natural athletic talent and leading to boredom (Juditya, 2023). In contrast, this research product adopts a movement literacy approach that is academically recognized for its ability to build students' self-confidence, holistic competencies, and intrinsic motivation to remain physically active throughout their lives (Salahuddin et al., 2025). This approach aligns with the characteristics of Phase F students, who are expected to explore according to their abilities in order to achieve adaptive and enjoyable PE (Kholis et al., 2024).

Operationally, the integration of technology through QR codes and a self-directed logbook in this textbook has proven effective in meeting students' needs for interactive learning. The use of e-modules or digital instructional materials in PE has been empirically shown to increase students' levels of active participation and autonomy in their learning outcomes (Gumara & Wahyuri, 2022). Furthermore, the provided logbook allows students to autonomously monitor their fitness progress outside of class hours, which is a tangible manifestation of student-centered learning (Hamid & Alberida, 2021). This is also supported by international studies demonstrating that interactive digital textbooks are highly effective in enhancing students' self-efficacy and engagement in the learning process (Chao & Sung, 2023).

Although it offers various advantages, some literature reviews present conflicting arguments regarding the disruptive impact of digital technology use in PE. The use of devices and digital screens on the field is often criticized for the risk of triggering a "sedentary paradox," in which students' active learning time is actually cut short by the duration of screen interaction rather than physical practice (Martín-Rodríguez & Madrigal-Cerezo, 2025). Furthermore, reliance on technological devices can distort authentic social interactions on the field and reduce movement-based learning to mere mechanical fulfillment of numerical targets (Zebua, 2023). Recognizing these contradictions, this textbook adopts an approach in which digital interactions are focused on assignments outside of school hours, ensuring that face-to-face time in the field remains purely focused on kinesthetic experiences.

From a pedagogical implementation perspective, the successful use of this innovative teaching material faces challenges related to educators' digital literacy and the readiness of the educational environment. Empirical evidence indicates that the main barriers to the digitization of PE are teachers' low understanding of Technological Pedagogical Content Knowledge (TPACK), as well as infrastructure limitations in some schools (Supriyanto et al., 2021). Therefore, the optimal use of digital textbooks must also be accompanied by continuous digital literacy training for educators (Kurniawati & Santoso, 2020). The highly user-friendly interface design of the textbook in this development

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product was specifically designed to minimize the technological confusion often experienced by teachers in the field (Sobarna et al., 2021).

Despite the various positive findings above, there are several weaknesses and limitations in this development study that need to be acknowledged as areas for improvement. First, the effectiveness test of the new product was conducted on a limited sample at State High School 4 Malang; therefore, generalizing its use to schools with different network infrastructures and geographic characteristics still requires further validation (Waruwu, 2024). Second, this study was limited to evaluating the feasibility of the design and its cognitive-psychomotor effectiveness in a short-term pre-test design (Creswell, 2014). The researchers have not yet measured the longitudinal impact of using this textbook logbook on clinically significant improvements in students' physical and cardiovascular fitness. These limitations form the basis for essential recommendations for future research to test the effectiveness of the textbook across a broader geographic scope and over a longer duration.

Limitations

Although the Phase F physical education instructional materials developed have been proven to be valid, practical, and effective, this study still has several limitations. The product trial was conducted at only one school—State Senior High School 4 in Malang—so the generalizability of the study's findings to other schools with different student characteristics, facility and infrastructure conditions, and learning environments remains limited. Furthermore, the assessment of the teaching materials' effectiveness focused primarily on their feasibility, practicality, and user feedback, and thus did not evaluate the long-term impact on improvements in students' learning outcomes, motor skills, or physical literacy. The integration of QR codes into the teaching materials also depends on the availability of digital devices and adequate internet access; consequently, their implementation may be less than optimal in schools with limited technological resources. Therefore, future research should involve a broader sample, conduct effectiveness tests using experimental designs, and develop more adaptive digital features so that the instructional materials can be used more effectively in various educational contexts.

CONCLUSION

Based on the results of the research and development conducted, it can be concluded that the PE Phase F textbook for the Merdeka Curriculum has proven to be highly valid, practical, and effective for use in instruction. This developed textbook no longer focuses exclusively on specific sports disciplines but successfully shifts the emphasis to movement literacy and fostering awareness of independent physical activity, in line with the philosophy of modern PE.

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In practice, this textbook greatly facilitates teachers and students in implementing differentiated instruction. The integration of QR codes and the inclusion of a logbook (Student Worksheet) allow students to independently manage their physical activities, both at school and outside of school. This study makes an important contribution by providing a prototype of adaptive PE teaching materials for the digital era, which can serve as a guideline for schools in Indonesia in educating students to become physically fit. As a recommendation, further development and implementation should be carried out on a broader school population scale with varying facilities and infrastructure, and long-term effectiveness testing is needed to measure the real impact of using this textbook on students' physical fitness status over time.

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AUTHOR CONTRIBUTION STATEMENT

All authors contributed to the completion of the manuscript. EF was responsible for the overall content of the manuscript and analyzed the data. ME and SH assisted in the completion of the manuscript and final revisions.

AI DISCLOSURE STATEMENT

The authors declare that no artificial intelligence (AI) tools were used in the preparation of this manuscript.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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