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Feasibility of Biopreneurship Project-Based Science Module for Students in the Bagek Kembar Ecotourism Area

X Zardht Alex Hidayat[1], I Putu Artayasa[2]*, A. Wahab Jufri[1]

[1] Science Education Study Program, Postgraduate, Mataram University, Mataram, Indonesia.
[2], Biology Education Study Program, Faculty of Teacher Training and Education, Mataram University, Mataram, Indonesia.

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Corresponding Author:
I Putu Artayasa
Artayasa75@unram.ac.id

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Abstract: The biopreneurship project-based science module is teaching material designed to combine biological concepts with entrepreneurship through project-based learning. This research aims to develop a biopreneurship-based science module valid for increasing students' scientific literacy, entrepreneurial motivation, and environmental literacy in the Bagek Kembar Ecotourism Area. This research is development research using the ADDIE model, namely Analyze, Design, Development, Implementation, and Evaluation. The development and validation stages of the module were carried out at the University of Mataram and SMA Negeri 1 Sekotong. The research instrument was a validation questionnaire given to science experts and teachers. The validity of the Science Module is based on the Aiken V Index. The results of the biopreneurship project-based science module validity show that the Aiken V Index for the size and appearance of the module cover, module design, module content, and language used are 0.95, 0.95, 0.93, and 0.94, respectively. Included in the valid category. This research concludes that the biopreneurship project-based science module is suitable for use in schools to increase students' scientific literacy, entrepreneurial motivation, and environmental literacy in Bagek Kembar ecotourism.

Keywords: Biopreneurship; Environmental literacy; Entrepreneurial motivation Project-based learning; Scientific literacy.

Introduction

The Bagek Kembar area is a mangrove ecosystem in Cendi Manik Sekotong Village, West Lombok, NTB (Dyani, 2021). This area has been rehabilitated for ecological purposes and developed into an ecotourism destination and education for elementary and middle school students (Farista & Virgota, 2021; Qudraty et al., 2023).). Bagek Kembar mangrove ecotourism has an area of around 86.46 hectares, with various mangrove species (Suyantri et al., 2023).

One effort to monitor and manage sustainable mangrove ecosystems is the cultivation of honey bees (Sambu et al., 2018). Cultivating honey bees can provide entrepreneurial motivation for residents while preserving the environment in the Bagek Kembar mangrove ecotourism area. Rhizophora stylosa is a mangrove species often found and flowers throughout the year in this ecotourism area, so this ecotourism area can potentially become a place for cultivating honey bees (Prayoga et al., 2018).

Honey bee cultivation can increase entrepreneurial motivation and strengthen the scientific and environmental literacy of local communities regarding mangrove ecosystems (Asim et al., 2019; Suheryadi et al., 2021). Therefore, the mangrove ecosystem can be a natural laboratory for educators to improve scientific and environmental literacy (Japa et al., 2021; Hayati et al., 2023).

Efforts to increase scientific literacy and environmental literacy of the mangrove ecosystem as well as increase the entrepreneurial motivation of the community in the Bagek Kembar Ecotourism Area need to be programmed thoughtfully so that local communities can take maximum benefit from the development of Bagek Kembar as a new economic development area. Currently, the Bagek Kembar Ecotourism Area is quite a favorite tourist dynasty and is a place for research on mangroves and ecosystem bird

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watching (Ecotourism Bagek Kembar, 2019). Genuine efforts to increase scientific and environmental literacy and entrepreneurial motivation have yet to be maximally carried out by the government and the private sector. Formal education also does not direct learning towards efforts to increase scientific and environmental literacy and students' entrepreneurial motivation. Learning in schools around the Bagek Kembar Ecotourism Area is more focused on developing knowledge in scientific fields that are more theoretical and monodisciplinary, and there are yet to direct activities in aspects that support the use of Bagek Kembar Ecotourism Continuous. Current conditions indicate the need for serious efforts to increase students' understanding of the mangrove ecosystem and its role as an Ecotourism Area. Science learning is essential in increasing students' scientific literacy by providing skills and understanding that are important for applying scientific concepts in everyday life in the surrounding environment (Juniati et al., 2020).

The need for more environmental literacy in local communities is still a severe problem, which creates difficulties in maximizing community participation in environmental conservation. Seriously impacts the mangrove ecosystem, so the dual function of the Bagek Kembar Ecotourism Area as a mangrove conservation area and an area that generates income for local communities needs to be improved. This condition emphasizes increasing environmental awareness through education (Santoso et al., 2021). Environmental literacy can be improved by providing good knowledge and awareness about the benefits of the mangrove ecosystem in the Bagek Kembar ecotourism area (Inge, 2024).

Education is vital in making people aware of the economic and ecological importance of the Bagek Kembar Tourism Area. Learning at schools targets many young people who carry out various activities in the ecotourism area. Thus, it is essential to carry out learning that applies an approach oriented towards utilizing ecotourism areas to obtain economic and ecological benefits. One learning approach that can be developed to combine science and entrepreneurship in science learning in ecotourism areas is biopreneurship. Biopreneurship creates value by utilizing unique biological resources to produce products or services to make a profit (Roslinda et al., 2021; Prasetyo & Kuntjoro, 2023). Biopreneurship is defined as using living things into a product that can be marketed to generate income (Aqil et al., 2020).

The biopreneurship approach will be practical if a suitable learning model facilitates it. The project-based learning model can develop students' entrepreneurial spirit by improving communication, critical, creative, and collaborative thinking skills, and interest in entrepreneurship (Haq, 2022). Project-based learning allows students to directly experience information presented through hands-on practice inside and outside the classroom. Project-based learning also causes students to be trained to work together, develop critical thinking skills, and increase their involvement in learning (Novitasari, 2023).

Implementing the biopreneurship approach in project-based learning requires tools in the form of learning modules so that the implementation of learning becomes more effective (Rosyidi et al., 2023). Developing project-based science modules that integrate biological and entrepreneurship concepts, besides improving learning outcomes, can also increase students' entrepreneurial creativity (Hawari et al., 2020; Yustina et al., 2020). The research results of Rosyidi et al. (2023) show that a biopreneurship project-based science module is effectively applied to biotechnology material. However, biotechnology is not the only learning topic that can be integrated with entrepreneurship. The mangrove ecosystem in Bagek Kembar Ecotourism also has the potential to be a biopreneurship project-based learning topic because the ecosystem in an ecotourism area contains material in addition to scientific literacy, environmental literacy, and entrepreneurship material. Therefore, this research aims to develop a science module based on a biopreneurship project and test the validity of the module so that it can be effectively applied to student learning in the Bagek Kembar Ecotourism Area.

Method

This type of research is included in research and development (R & D). The model used to develop the biopreneurship project-based science module in this research is ADDIE, which consists of the Analysis, Design, Development, Implementation, and Evaluation stages (Rustandi, 2021; Ashari et al., 2022). In the initial analysis stage, a curriculum analysis was carried out, and the need to develop a biopreneurship project-based science model by giving questionnaires to four teachers and twenty-four students. In contrast, in the design stage, the module design included the module form, cover appearance, contents, student learning activities, and evaluation form. A validity test of the developed module is carried out at the development stage (Figure 1).

Four expert validators carried out the validity test of the biopreneurship project-based science module by filling in the validation instrument sheet. The module validation instrument consists of 27 questions/statements grouped into four aspects or assessment indicators: module size, module design, material content, and language. Each validator gives a score to each question item using a measurement scale (rating scale) with assessment criteria consisting of not

feasible (score 1), less feasible (score 2), somewhat feasible (score 3), feasible (score 4), and highly feasible (score 5).not feasible (score 1), less feasible (score 2), quite feasible (score 3), adequate (score 4), and very worthy (score 5). The validator assessment results are tabulated, and then a module feasibility analysis is carried out using the Aiken (1985) Formula (Formula 1).

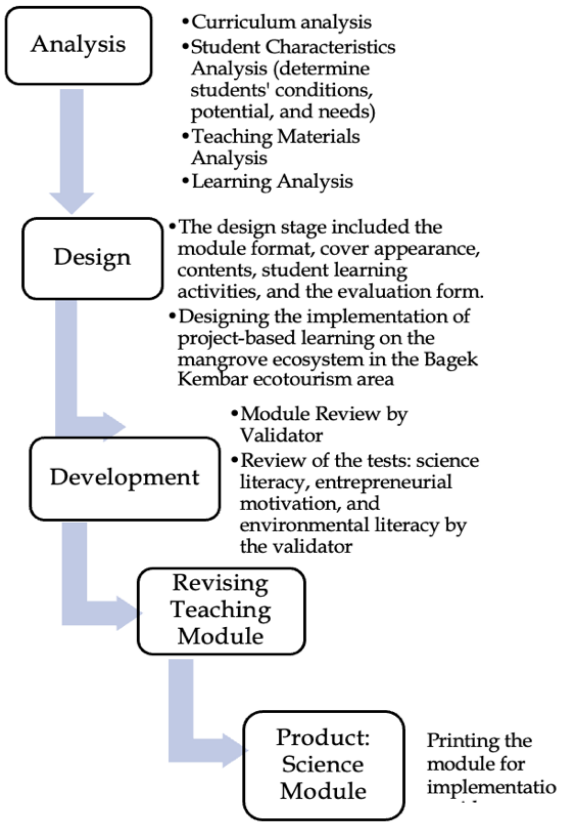

Figure 1. Science module development flowchart

$V = \sum S / [n(C-1)]$, where: (1)
S = R – Lo
V = Aiken index
S = the score given by the assessor is reduced lowest score in the category
R = score given by assessors 1, 2, 3, and 4.
Lo = lowest assessment score (1)
C = highest assessment score (5)
n = number of validators (raters)

According to Utami et al. (2024), if the Aiken Index is less than 0.4, then it is said to have low validity; the index between 0.4 and 0.8 is said to have medium validity, and if it is more than 0.8, it is said to have high validity.

Result and Discussion

Analyze Stage

The analysis stage was carried out to determine students' conditions, potential, and needs at SMA Negeri 1 Sekotong regarding learning. The analysis results show that the curriculum used in this school is independent. This school is also close to a mangrove area, which is used as an ecotourism site. The school uses the mangrove area as a place for students to study by holding nature classes. However, the teaching modules still need to be improved to support students in these activities and help them develop their regional potential. The results of the analysis of teaching materials also showed that 10th-grade science students studied ecosystem material, which could be integrated with biopreneurship project activities to help students develop the potential of their region. One way to exploit the potential in ecotourism areas is through entrepreneurship. Entrepreneurial motivation should be instilled in students from an early age through educational activities (Putri & Nawawi, 2024). The entrepreneurial activities implemented will improve if integrated with efforts to preserve the mangrove ecosystem. In this case, it is essential to apply the Eco Edu concept, namely providing education regarding the function of the ecosystem in the Mangrove Ecotourism Area in education (Mirza et al., 2022).

Learning analysis also targets scientific literacy, environmental literacy, and entrepreneurial motivation. The results of the needs analysis for these three aspects of developing biopreneurship project-based science modules are shown in Tables 1 and 2. The data in Table 1 and 2. emphasizes the responses from 24 students regarding the importance of scientific literacy, entrepreneurial motivation, and environmental literacy in science learning, especially ecosystem topics.

Table 1. Student Responses to the Need for Scientific Literacy in Learning.

Science Literacy Questions	Student response
- Has the teacher ever explored aspects of scientific literacy in the learning process?	100% of students said they had
- How does the teacher explore aspects of science literacy in the learning process?	1. Integrating science learning into daily life and collaborative activities (63%). 2. Practicing students' reading skills (25%) 3. Through discussions and applied learning (12%)
- In students' opinion, is it necessary to develop aspects of scientific literacy in the learning process? Explain!	1. Essential (75%) 2. Necessary (25%). 3. The reasons: gain knowledge to face challenges, think critically, be technologically literate, encourage innovation

Table 2. Student Responses to the Need for Entrepreneurial Motivation, and Environmental Literacy in Learning

Questions	Student response
Entrepreneurial Motivation	
- Has the teacher ever explored aspects of Entrepreneurial Motivation in the learning process? Explain!	100% declared yes
- How does the teacher explore aspects of Entrepreneurial Motivation in the learning process?	1. Questions and answers (oral) 83% 2. Tasks (13%) 3. Others (4%)
- In students' opinion, is it necessary to develop aspects of Entrepreneurial Motivation in the learning process? Explain!	100% said it was necessary because it would give students learning about entrepreneurship and benefits for life.
Environmental Literacy	
- Has the teacher ever explored aspects of environmental literacy in the learning process?	100% say yes
- How does the teacher explore aspects of environmental literacy in the learning process?	Integration of environmental material, project activities to strengthen the profile of Pancasila students, utilizing environmental potential.
- In students' opinion, is it necessary to develop environmental literacy in the learning process? Explain why!	1. Essential (75%) 2. Necessary (25%) 3. The reason is to increase environmental insight and awareness.

Based on Table 1 and 2, all students stated that scientific literacy, entrepreneurial motivation, and environmental literacy needed to be strengthened in Biology learning. The main reasons students agree on strengthening scientific literacy are to gain knowledge to face challenges, think critically, be technologically literate, and encourage innovation. Entrepreneurial motivation needs to be given to students because it provides them with entrepreneurial learning and is beneficial for life. In contrast, environmental literacy is needed because it helps increase environmental insight and awareness.

Entrepreneurial activities can help improve students' scientific literacy skills in understanding surrounding natural phenomena. Based on the questionnaire results shown in Table 1, exploring and motivating students for entrepreneurship is limited to questions and answers and giving assignments, not through actual actions that motivate students to become entrepreneurs. One entrepreneurship that students can learn about is cultivating honey bees in the mangrove ecosystem. Honey bee cultivation has potential in this area because of the presence of mangrove vegetation as natural food for honey bees, such as the mangrove species Rhizophora stylosa, which is widely found and flowers throughout the year. The concept of combining biological sciences with entrepreneurship is called biopreneurship (Prasetyo & Kuntjoro, 2023). Based on the analysis results, a science module based on the honey bee cultivation biopreneurship project was developed to help increase students' scientific literacy, entrepreneurial motivation, and environmental literacy.

The data in Table 3 shows the need to apply a biopreneurship approach to project-based learning. Based on the questionnaire results, all students stated that implementing the biopreneurship approach was necessary for learning because learning about entrepreneurship benefits life. Unfortunately, this approach has so far been limited to biotechnology topics such as the practice of making tempe and tape, which was carried out in the project to strengthen the profile of Pancasila students. In contrast, the opportunity to gain economic benefits from the mangrove ecotourism area has yet to be carried out at the school. All students also stated that project-based learning is essential because it trains students to innovate in learning, and modules or teaching materials are needed to help students understand the subject matter in more depth.

Table 3. Student Responses to the Importance of the Biopreneurship Approach and Project-Based Learning.

Question	Student response
- How does the teacher apply aspects of biopreneurship in the learning process?	Practice making tempe and tape in project activities to strengthen the profile of Pancasila students.
- In students' opinion, is it necessary to apply a biopreneurship approach to the learning process? Explain why?	100% of students said it was necessary The reason: learning entrepreneurship is beneficial for life.
- How does the teacher implement project-based learning in the learning process?	Working on projects in groups (87%) Practicum (13%)
- In the teacher's opinion, is it necessary to implement project-based learning in the learning process? Explain why?	100% stated necessary The reason is to train students to innovate in learning.
- In students' opinion, is it necessary to use learning modules in the learning process? Explain why!	100% stated necessary The reason is to understand the material in depth

The results of distributing questionnaires to four science teachers at SMAN 1 Sekotong are shown in Table 4. Based on the results of the questionnaire, teachers must implement a biopreneurship approach in project-based learning that utilizes the school environment and

mangrove ecosystem in the Bagek Kembar Ecotourism area. So far, the biopreneurship approach has been carried out through projects making tempeh and tape (biotechnology topics). The biopreneurship approach to the tempeh and tape-making project was carried out to support the project and strengthen the profile of Pancasila students. This project is part of the activities in the Merdeka Curriculum. The project to strengthen the Pancasila student profile is aimed at providing opportunities for students to "experience knowledge" as a process of strengthening character, as well as an opportunity to learn from the surrounding environment. In this project activity, students are facilitated with essential themes or issues such as climate change, entrepreneurship, and technology so that students can take real action in responding to these issues according to their learning stages and needs (Satria et al., 2022). Implementing projects to strengthen Pancasila students is generally limited (Farhana & Cholimah, 2024), which can be due to limited guidebooks for project implementation by utilizing local potential. Thus, developing biopreneurship project modules is essential as a guide for student learning. Based on the questionnaire results, the teacher stated that the mangrove ecosystem is a learning topic that can be used in bioprenuership project-based learning.

Table 4. Results of Analysis of Teacher Needs in Learning

Needs Analysis Indicators	Teacher 1	Teacher 2	Teacher 3	Teacher 4
- The Biopreneurship approach	Required Reason: Increase students' interest in entrepreneurship	Required The reason: To improve students' life skills	Required	Required
- Barriers to implementing the biopreneurship approach	Difficulty in monitoring student activities	Students' interest in learning is lacking	The study guide is not yet available	Difficulty designing biopreneurship activities
- Project Based Learning	Required to support the project to strengthen the profile of Pancasila	Necessary to improve students' skills	Required to support the project to strengthen the profile of Pancasila	Required to practice critical and creative thinking skills
- Modules or teaching materials	Required Reason: to facilitate the learning process	Required Reason: So that learning is directed	Required Reason: improve students' cognitive abilities	Required
- An ecosystem that functions as a learning resource	Mangrove	School environment	School environment	School environment

Design Stage

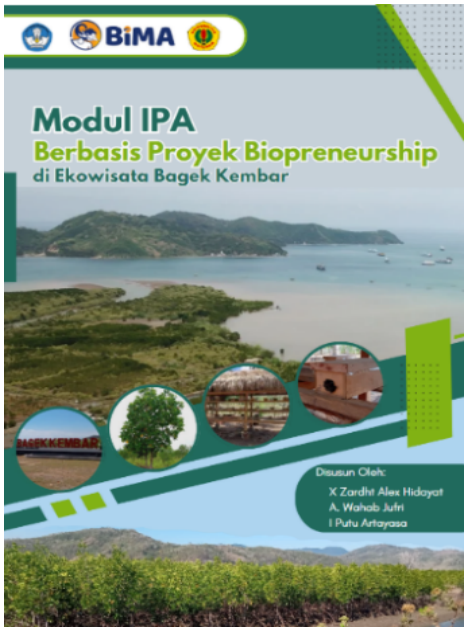

Figure 2. Cover of the Biopreneurship Project Science Module

The design stage is based on the results of curriculum analysis and previous learning. The developed modules' learning tools and validation instruments are planned at the design stage. Next, at the design stage, a biopreneurship project-based science module was designed on ecosystem materials. The composition of the module developed consists of a cover, the beginning of the module (Figure 2), the contents of the module, and a biopreneurship project worksheet. The module is designed using Microsoft Word 2019 and Application Canva. After that, the results of the science module design were printed and reproduced in book form. Students are distributed modules in groups during the learning process.

Development stage

1. Biopreneurship Project-based Science Module Validation Test Results

The biopreneurship project-based science module that had been developed was then assessed by five experts. The results of the validator assessment suggest several revisions that must be made before the module

is assigned to the learning process at the target school. The advice given by the validator is to choose images that are relevant with sentence descriptions of the content or content of the learning topic, presentation of questions and problem-solving should be arranged in simple sentences, and integration of the material with biopreneurship projects is carried out based on the potential that exists in the Bagek Kembar Ecotourism Area.

Validation of scientific literacy, entrepreneurial motivation, and environmental literacy modules and instruments is carried out to determine the validity of the product before being applied to the learning process. The feasibility of a biopreneurship project-based science module is based on four assessment indicators: module size, module design or appearance, learning content, and language. The expert validation results can be seen in Table 5.

Table 5. Expert validation test results for the Biopreneurship Project-Based Science module

Validator	Feasibility Indicators for Biopreneurship Project-Based Science Modules			
	Module size and cover appearance	Design	Content	Language
Index Aiken v	0.95	0.95	0.93	0.94
Conclusion	Valid	Valid	Valid	Valid

Based on the results of validity tests from five validators, appropriate criteria were obtained for each aspect or product indicator. The feasibility value of module size and cover appearance is obtained by an Aiken v index of 0.95, which includes valid criteria. The validation results of the module design aspects show an aiken v index of 0.95. This result means that the module design displayed is attractive, with harmonious variations of writing and images. This assessment reflects that the module has an attractive appearance, with the choice of color and cover design based on the module's contents. The font used is Times New Roman, with font sizes ranging between 10-14, and the layout is well organized, including sufficient spacing between lines to ensure the text can be read clearly. Adding relevant images and video links also supports the delivery of the material. The images used in the module have accurate shapes and colors and are familiar to students (Putri et al.,2022). Furthermore, consistent and proportional size and presentation of letters, according to their function in teaching materials, can increase student motivation.

Validity in the content aspect shows the Aiken v index of 0.93, which indicates that the material presented is good, has clear concepts and does not cause misunderstandings. The images in the module are by reality. The material presented has been adapted to the Independent Curriculum, including conformity with the learning outcomes and objectives in Minister of Education and Culture Regulation No. 033/H/KR/2022. The material presented in the module also refers to valid and reliable sources or books, such as books that review the mangrove ecosystem in the Bagek Kembar Ecotourism Area in detail (Ahmad, 2024). The suitability of the material plays a role in increasing motivation, interest in learning, and the user's desire to study the content presented in the teaching materials that have been developed (Astuti, 2022). The suitability of the content of a teaching material can be assessed from the systematic and detailed preparation of the material regarding the concepts presented (Sari, 2020).

The results of the validity of the module in the language aspect obtained an Aiken value of 0.94 with valid criteria. Assessment of the language aspect is based on the sentences used in the module being developed. The sentences correctly convey information, use simple language according to the student's ability level, and use the terms by the KBBI (Big Indonesian Dictionary). The spelling follows EYD (Improved Spelling) rules. Suitable teaching materials use simple, short, clear, and unambiguous language because it can influence the communicative aspect of the learning resource (Fegiarti, 2023). Printed materials also need to pay attention to the use of language that is easy to understand, including the choice of vocabulary, clear explanations, and sentences that are not too long so that they are easy for students to understand (Sari, 2020).

2. Results of Evaluation Tool Validation Tests on Biopreneurship Project-based Science Modules

The evaluation tools used in biopreneurship project-based learning are first assessed by experts to ensure whether the evaluation tools are suitable for use. The validator suggests several revisions before the instrument is declared suitable for use. The suggestions given by the validator were to adjust the question indicators to each variable being measured, present the questions short and easy to understand, and use question material related to the Bagek Kembar ecotourism ecosystem and the concept of biopreneurship. The question instruments that are assessed consist of instruments about scientific literacy, entrepreneurial motivation, and environmental literacy. The results obtained from the expert validation results on the test instrument can be seen in Table 6.

Table 6. Validity of the Scientific Literacy, Entrepreneurial Motivation, and Environmental Literacy tests

	Scientific Literacy	Entrepreneurial Motivation	Environmental Literacy
Index Aiken v	0.90	0.91	0.92
Conclusion	Valid	Valid	Valid

Table 6 shows that the average Aiken v scores obtained from the three tests are 0.90 for scientific literacy, 0.91 for entrepreneurial motivation, and 0.92 for environmental literacy. Based on these results, all tests were assessed in the appropriate category. This result shows that the three evaluation tools developed are declared valid so that they can be used to measure students' learning abilities at school, especially in scientific literacy, entrepreneurial motivation, and environmental literacy.

Conclusion

The biopreneurship project-based science module developed is in the appropriate category regarding module size, module design or appearance, lesson content, and language. The test instruments of scientific literacy, entrepreneurial motivation, and environmental literacy were also declared to be in the appropriate category. Based on the validation results by the five validators, it was found that the biopreneurship project-based science module was feasible for use in schools to increase students' scientific literacy, entrepreneurial motivation, and environmental literacy in Bagek Kembar ecotourism

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Author Contributions
I Putu Artayasa contributed to compiling the research design, analyzing research data, and reviewing the article. XZardht Alax Hidayat contributed to conducting observations in the field, distributing module validation questionnaires to validators, developing science modules based on biopreneurship projects and instruments for scientific literacy, entrepreneurial motivation, and environmental literacy, and preparing draft articles. A Wahab Jufri reviewed and revised the science module and the three types of tests.

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Conflicts of Interest
The authors declare no conflicts of interest related to the results of this research and published articles

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