

# Development of Interactive Multimedia based on *Problem-Based Learning* to Improve IPAS Learning Outcomes

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**Abstract:** This research is an R&D (Research and Development) study with the Borg and Gall model. This research is motivated by the fact that teachers have not been optimal in using technology-based learning media and innovative learning models. This causes the low learning outcomes of grade V students on the material of the human digestive system. This research aims to develop media design, test the feasibility, and test the effectiveness of interactive multimedia based on problem-based learning. The techniques used in data collection are tests and non-tests (observation, interviews, questionnaires, and documentation). The results showed that (1) interactive multimedia was developed using the Canva application with components including cover, main menu, instructions, problem-based learning-based material, games, evaluation, and developer profile; (2) product feasibility from media experts 93.75%, material experts 92.5%, student responses 97.27%, and teacher responses 98.75% with very feasible criteria; (3) effectiveness seen from the increase in learning outcomes of 19.4948 and sig. (2-tailed) value of 0.000 which shows there is a significant difference in students before and after using interactive multimedia. The N-Gain test obtained was 0.4911 which showed medium criteria. The conclusion of this study states that interactive multimedia based on problem-based learning has been successfully developed, feasible, and effective in improving the learning outcomes of human digestive system IPAS of fifth-grade students of SD N 1 Ngadirejo Temanggung.

**Keywords:** Digestive system; Interactive multimedia; IPAS; Learning outcomes; Problem-Based Learning

## Introduction

Education is essential for human survival. One of the mandated goals of the Indonesian state in the opening of the 1945 Constitution in the fourth paragraph is to educate the nation's life. With this mandate, the Indonesian state must properly educate its citizens. Education is a determining factor in advancing the quality of human resources (Mairina & Hadiyanto, 2022). Quality education will have a good influence on various fields to produce a generation with dignity, superior quality, and noble character.

Education will be organized and directed by the curriculum. The curriculum consists of objectives,

content, teaching materials, and strategies that are used as guidelines in organizing the learning process to achieve a predetermined goal. At this time, the curriculum being implemented is the Merdeka Curriculum. In the Merdeka Curriculum, teachers have the power to choose and develop various learning tools so that learning is based on the learning needs and interests of students.

The learning tools made by teachers are adjusted to the learning outcomes according to the grade level. Learning outcomes are learning competencies that students must achieve in each phase. The structure of the independent curriculum is stated in the Decree of the Minister of Education, Culture, Research and

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Technology of the Republic of Indonesia Number 262 / M / 2022, stating that learning outcomes for SD / MI equivalent levels are divided into three phases, namely phase A for grades I and II, phase B for grades III and IV, and phase C for grades V and VI.

The learning outcomes of Natural and Social Sciences subjects need to be understood as a whole. The teacher is the first party to engage with students directly in providing explanations during the learning process. In the era of society 5.0, humans can be said to coexist with technology (Izhar et al., 2023). Mastery of technology both virtual and real will be a measure of one's progress. The way that will be done in facing society 5.0 is to involve existing infrastructure in Indonesia, develop existing human resources, and use technology in the field of education as a tool for learning activities (Ariastika, 2022).

In learning, teachers are required to be able to create active learning situations, especially science learning (Rahmawati et al., 2021). The development of Indonesian children's science literacy skills has decreased (Nugraha, 2022). This can be seen from the development of PISA (Program for International Student Assessment) data in 2018. According to PISA data in 2018, the average science literacy score of students in Indonesia was 396, this has decreased from the PISA results data in 2015 with an average score of Indonesian science literacy of 403. From the PISA data, it can be seen that the condition of the science literacy skills of Indonesian students tends to be not optimal.

Based on the results of pre-research through observations, interviews, questionnaires, and document data conducted on fifth-grade teachers and fifth-grade students of SD N 1 Ngadirejo, Ngadirejo District, Temanggung Regency, researchers found that teachers were not optimal in utilizing technology-based learning media. The main role in learning activities is held by learning media (Wayan Illia Yuda Sukmana et al., 2023). Along with the times, technology is developing very quickly so it has a huge impact on some aspects of human life, one of which is in the field of education. The media used in daily learning tends to use concrete media available at school. In addition, the lack of interactive learning media causes the learning process to be ineffective. Teachers should not only explain the material but must be able to create learning that involves technology so that learning can be optimized and students are interested in participating in learning.

Teachers have not optimally used innovative learning models. In IPAS learning, the teacher is always the center of learning or it can be called Teacher Centered Learning (TCL) so that it makes students not active in the learning that is done. The model used is usually used by teachers, namely the teacher explains

and students only listen, there is no question-and-answer interaction between teachers and students. This model makes students less active and the teacher is not maximized in understanding students whether they understand the material given or not.

Researchers also found that the learning outcomes of students' daily tests on the subject of IPAS material on the Digestive System in Humans were still low. Based on document data, the learning outcomes of fifth-grade students of SD N 1 Ngadirejo, Ngadirejo District, Temanggung Regency, which are classified as low, show that of the 33 students, there are 24 students (73%) who get scores below the average and 9 students (27%) have obtained scores above the average, namely above 70.

Students experience difficulties, especially in learning material about the human digestive system in science lessons. The material provided cannot only be explained using text alone, students need to see and know how the digestive system is. The scope of material that is still classified as difficult for fifth-grade students of SD N 1 Ngadirejo is when mentioning the organs and functions of the digestive organs in humans, distinguishing types of the human digestive system, the mechanism of the digestive system in humans, nutrients needed by the body, and various disorders of the digestive system in humans.

Based on the problems obtained, to improve learning outcomes that are expected to improve learning outcomes in human digestive system material, an interactive learning media is needed. Agree with Putri Pratiwi et al. (2023) that the way that teachers can apply is through the utilization of current technological developments. Through the use of digital technology as media, teachers can visualize science concepts that are still difficult for students to understand interestingly and are easily understood by students (Yafa et al., 2022).

According to Nurhalisa & Sukmawarti (2022), learning media not only acts as a tool for teachers to convey learning material but is also able to increase students' learning motivation and foster their curiosity about the material being taught. Learning media helps students to focus on the material provided by the teacher (Untari & Rahayu, 2022). The learning media in question is media that can combine audio, images, video, and animation into a component that creates interaction between students and teachers to increase student enthusiasm for learning.

The combination of several media is summarized into multimedia. To stimulate learners' activeness, multimedia is designed interactively. In multimedia, students can control the elements so that the multimedia is said to be interactive multimedia (Pradnyawati & Rati, 2023). This is in line with the opinion of Kumalasan (2018) that learners can operate interactive multimedia

directly which makes learners' enthusiasm increase. With the use of interactive multimedia, students can explore learning materials in various ways (Shahzad et al., 2021). Interactive multimedia in science subject content is a combination of text, sound, images, and videos together so that in learning science it makes students interested, effective, and efficient so that it can be more easily understood (Sylvia Lara Syaflin, 2022). The use of interactive multimedia will make it easier for students to understand abstract material (Arina et al., 2020). Juniari & Putra (2021) in their research also stated that interactive multimedia is highly recommended for teachers as a tool in learning so that it can improve science learning outcomes in students.

The utilization of innovative learning models is very necessary. One of the effective learning methods suitable for use with students according to their abilities is Problem-Based Learning (PBL) (Santi et al., 2023). The problem-based learning model begins by presenting problems that are relevant to everyday life based on the learning objectives to be achieved (Masitoh, 2023). The problem-based learning model consists of five steps, namely introducing students to the problem, organizing students for the learning process, guiding individual and group investigations, developing and presenting results, and evaluating the problem-solving process (Ferdiansa et al., 2023).

Learning outcomes refer to the achievements made by students after taking the evaluation given by the teacher. Through these learning outcomes, teachers can evaluate whether the learning objectives have been achieved or not. Therefore, the development of interactive multimedia is supported by previous research, such as that conducted by Rahmadhani and colleagues (2022), which shows that interactive multimedia meets standards, is interesting, and is very suitable as a learning tool to improve student learning achievement. The findings are also reinforced by research by Dwiqi et al. (2020), as a result, the use of interactive multimedia in the learning process proved to be very successful in triggering students' interest in learning and was able to significantly improve learning outcomes because learning was done interactively.

Based on this background, it is known that the development of interactive multimedia is feasible in learning. The use of a problem-based learning model is effective in improving students' learning outcomes. Researchers developed interactive multimedia based on problem-based learning to improve the learning outcomes of IPAS class V students of SD N 1 Ngadirejo Temanggung. This multimedia is made based on a problem-based learning model where students are given a problem at the beginning of learning, then students are organized to learn, guided to conduct investigations,

develop and present work, and finally be able to analyze and evaluate the problem-solving process. With problem-based learning multimedia, students are more interested and able to think critically to get maximum scores. The formulation of the problem in this study is how the design of interactive multimedia development, the feasibility of interactive multimedia, and how the effectiveness of interactive multimedia based on problem-based learning on the material of the digestive system in humans in class V SD N 1 Ngadirejo Temanggung. The purpose of this research is to develop interactive multimedia design, test the feasibility of interactive multimedia, and test the effectiveness of interactive multimedia based on problem-based learning on human digestive system material in class V SD N 1 Ngadirejo Temanggung.

## Method

The research used by researchers is a type of R&D (Research and Development) research which is commonly referred to as research and development. According to Sugiyono (2017: 297), research and development methods are research techniques used to create a product and evaluate how effective the product is. Researchers used the Borg and Gall development model for the stages of the research conducted. According to Sugiyono (2017: 298), the sequence of research and development consists of 10 steps, namely 1) potential and problems, 2) data collection, 3) product design, 4) design validation, 5) design revision, 6) product trial, 7) product revision, 8) trial use, 9) product revision, and 10) mass production. The product developed by the researcher is Interactive Multimedia based on Problem-Based Learning to Improve the Learning Outcomes of IPAS Class V Students of SD N 1 Ngadirejo Temanggung.

The initial analysis was carried out by researchers exploring the potential and problems carried out in class V SD N 1 Ngadirejo Temanggung through observations during learning, interviews with class V teachers, questionnaires, and documentation in the form of learning outcomes. In addition, researchers also evaluate the needs required by students and teachers. To assess whether the developed product is appropriate, researchers will ask for an assessment from validators who are experts in the field of media and material. The results of the feasibility data percentage can be converted with as Table 1.

**Table 1.** Assessment Criteria

Percentage (%)	Criteria
81-100	Very Feasible
61-80	Feasible
41-60	Less Feasible
21-40	Not Feasible
0-20	Very unfeasible

The effectiveness of interactive multimedia using a problem-based learning approach was analyzed by comparing pretest and posttest scores during the learning process. This analysis includes a normality test, paired sample t-test, and N-Gain test. The normality test was conducted using the Shapiro-Wilk test formula with the help of the SPSS 23 application. The t-test was also conducted using the same application. The final stage of data analysis is the N-Gain test, which aims to show the improvement of student learning outcomes before and after learning. The formula used in calculating N-Gain aims to provide an overview of the improvement of student learning outcomes as follows. (Lestari, K & Yudhanegara, 2017).

$$N-Gain = \frac{\text{score posttest} - \text{score pretest}}{\text{score maximum} - \text{score pretest}} \tag{1}$$

The results are classified based on predetermined criteria in Table 2.

**Table 2.** N-Gain Assessment Criteria

Value	Criteria
N-Gain ≥ 0.70	High
0.30 ≤ N-Gain < 0.70	Medium
N-Gain < 0.30	Low

## Result and Discussion

The research used is a type of development research or R&D (research and development) with the results of Interactive Multimedia products based on Problem-Based Learning. This multimedia is in the form of a link so that it is easily accessible to anyone and anywhere.

### *Development of Interactive Multimedia Design based on Problem-Based Learning*

Based on the Borg and Gall development model, the development design of Interactive Multimedia based on Problem-Based Learning is as follows.

### *Potential and Problems*

The potential that exists in the school is something that has added value. The problems that occur are the gaps between what is expected and what happens. Exploration of potential and problems carried out in class V SD N 1 Ngadirejo Temanggung through observation during learning, interviews with class V

teachers, questionnaires, and documentation in the form of learning outcomes in science subjects on human digestive system material.

The results obtained based on the research are (1) the teacher has not been optimal in utilizing technology-based learning media, (2) the teacher has not been optimal in using innovative learning models, (3) the daily learning results of students in IPAS subjects are still low, and (4) the difficulties faced by students in learning science subjects lie in the material of the human digestive system.

### *Data Collection*

Data collection obtained by researchers is used as product planning or design to overcome learning problems that occur in class V SD N 1 Ngadirejo Temanggung. The data collection carried out by researchers is by analyzing the questionnaire of students' needs and teachers' needs. The results of the questionnaire are useful for researchers in designing interactive multimedia to be made so that it can solve existing problems according to the needs of students and teachers. Making interactive multimedia according to student needs is expected to increase student enthusiasm and interest in the learning process so that learning becomes more effective.

### *Product Design*

The design stage is an activity of designing and designing products needed by students and teachers. The activities carried out by researchers at this stage are designing learning tools that will be used when learning takes place. One good learning medium is using the Canva application. Canva can help teachers make media make it easier to explain the material to be taught (Kamila & Kowiyah, 2022). Various kinds of templates contained in Canva can be used as learning aids (Imelda, 2023). The Canva application is an application that provides various online design programs such as presentations, posters, pamphlets, brochures, and so on (Wahyuni & Napitupulu, 2022). Researchers use the help of the Canva application by combining text, sound, images, and videos into one unit. With practical media packaging, it can support the achievement of the desired learning objectives (Fitria et al., 2022).

Interactive multimedia can be said to be able to change the attitudes and behavior of students toward creative and dynamic changes (Asmita et al., 2018). Interactive means that the multimedia developed has the advantage of two-way communication so that students take part when multimedia is used (Ratnasari et al., 2021). The interactive multimedia developed has content based on the Problem-Based Learning model. Through this model, learning will be centered on

students so that students can work together and exchange knowledge (Ariyani & Kristin, 2021). In addition, researchers use hyperlinks in making products to produce interactive multimedia. The results of the development of Interactive Multimedia based on Problem-Based Learning are presented in Figure 1.



Figure 1. Cover Page

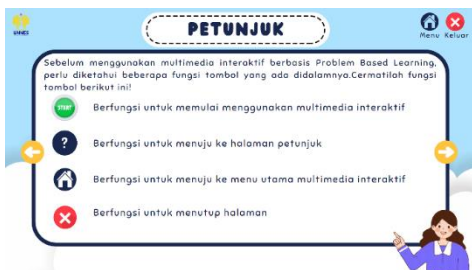


Figure 2. Instructions Page



Figure 3. PBL Syntax Phase 1



Figure 4. PBL Syntax Phase 2

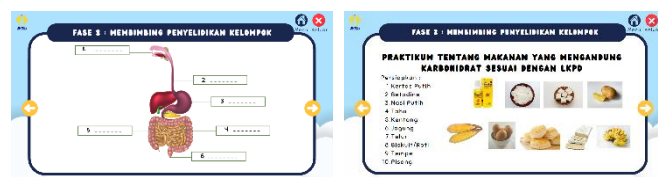


Figure 5. PBL Syntax Phase 3



Figure 6. PBL Syntax Phase 4



Figure 7. PBL syntax Phase 5

Design Validation

Design validation is an activity to assess whether the product design will be feasible to use or not. The product validation stage is carried out by providing an assessment validation questionnaire with the validator providing a checklist on each aspect of the assessment. Media expert validators assess the feasibility of interactive multimedia based on problem-based learning while material expert validators will provide the feasibility of the content of the material, namely the material of the digestive system in humans. Both experts provide suggestions for improvement if there is still media and material that is not suitable.

Design Revision

Improvements were made based on evaluations from expert assessments in the fields of material and media. There are revisions or improvements because there are deficiencies in the learning media and materials developed by researchers. In the product that I developed, there was a revision, namely the addition of a concept map to the material. After revision, the researcher will get an assessment and the product can be used in schools.



Figure 8. Concept Map Page

Small-Scale Product Trial

The product trial stage is the stage of implementing the product to students directly using Interactive Multimedia based on Problem-Based Learning. In the small-scale trial, researchers took a sample of 6 students where 2 students were at the top rank, 2 students were at the middle rank, and 2 students were at the lowest rank. In the small-scale trial, researchers gave response questionnaires to students and teachers to determine the feasibility of interactive multimedia and conducted pretests and posttests to determine the effectiveness of interactive multimedia based on problem-based learning on digestive system material in class V SD N 1 Ngadirejo. This was done to be a basis for consideration in the large-scale use trial later.

*Product Revision*

At this stage, the researchers received good responses and there were no suggestions or comments on the questionnaire that had been given. Based on this, the Interactive Multimedia based on Problem-Based Learning is suitable for large-scale usage trials.

*Large-Scale Usage Trial*

In this large-scale trial, researchers conducted trials involving all fifth-grade students of SD N 1 Ngadirejo with a total of 33 students. Students work on questions in the form of pretests and posttests after learning takes place. In addition, students also filled out responses to the interactive multimedia developed by researchers. This trial was conducted to validate and find out for real that the products developed by researchers are feasible and effective in the learning process.

*Feasibility of Interactive Multimedia Based on Problem-Based Learning to Improve IPAS Learning Outcomes on Digestive System Material in Humans*

The feasibility assessment of Problem-Based Learning-based Interactive Multimedia was carried out by media experts and material experts. The results of the assessment of media experts and material experts are seen in Table 3.

**Table 3.** Media and Material Expert Validation Results

Expert	Score	Total Score	Percentage (%)	Criteria
Media	75	80	93.75%	Very Feasible
Material	74	80	92.5%	Very Feasible

In the validation of media and material experts, researchers used 20 statements to be assessed by media expert validators. The score obtained from the media expert is 75 out of a total score of 80 so it gets a percentage of 93.75% with very feasible criteria. Meanwhile, the score obtained from the material expert received a score of 74 out of a total score of 80, so the percentage is 92.5% with very feasible criteria.

According to the evaluation of media experts and material experts on Interactive Multimedia based on Problem-Based Learning to improve IPAS studies learning outcomes of grade V students at SD N 1 Ngadirejo Temanggung, the product is considered very feasible to use. Based on this assessment, interactive multimedia can be applied and utilized in the learning context as in the research.

Learners and teachers participated in providing an assessment of the interactive multimedia developed. Teachers and students were given responses to determine the feasibility of problem-based learning-based interactive multimedia that researchers have developed.

In the questionnaire assessment of student's responses, it obtained a score of 231 out of a total score of 240 so it obtained a calculation of 96.25% which was included in the very feasible criteria. Meanwhile, the teacher response questionnaire assessment obtained a score of 79 out of a total score of 80 with a calculation of 98.75% so it fell into very feasible criteria.

In the large-scale use trial, the results of the responses of students and teachers were given to 33 students and teachers after the students finished doing the posttest. The following are the results of the acquisition of student and teacher responses to Interactive Multimedia based on Problem-Based Learning.

**Table 4.** Results of Small-Scale Response

Response	Total Score	Percentage (%)	Criteria
Students	231	96.25%	Very Feasible
Teacher	79	98.75%	Very Feasible

**Table 5.** Results of Large-Scale Response

Response	Total Score	Percentage (%)	Criteria
Students	1284	97.27%	Very Feasible
Teacher	79	98.75%	Very Feasible

According to the results of the response survey to interactive multimedia using a problem-based learning approach, out of 33 students, a score of 1284 out of a total score of 1320 was obtained, which is equivalent to a percentage of 97.27%. Meanwhile, the score given by the teacher was 79 out of a total score of 80, equivalent to a percentage of 98.75%. These results show that interactive multimedia that applies a problem-based learning approach is considered very suitable for use and provides good benefits for students and teachers.

*The Effectiveness of Interactive Multimedia Based on Problem-Based Learning to Improve IPAS Learning Outcomes on Digestive System Material in Humans*

Testing the effectiveness of interactive multimedia is done through a series of tests, including normality test, t-test (paired sample test), and N-Gain test. The normality test aims to determine whether the data from the pretest and posttest have a normal distribution or not. Researchers used the Shapiro Wilk normality test, with the help of the SPSS 23 application, in the context of developing interactive multimedia based on problem-based learning, considering that the number of fifth-grade students of SD N 1 Ngadirejo involved was less than 50, namely 33 students. The test criteria according to Priyatno (2018) are: If the significance  $\leq 0.05$  then the data is not normally distributed. If the significance  $> 0.05$  then the data is normally distributed

**Table 6.** Normality Test Results

Action	N	Mean	Sig.	Category
Pretest	33	59.2930	0.249	Normal
Posttest	33	78.7879	0.296	Normal

Based on table 6. Normality Test Results can be seen in the significance value obtained. In the pretest, the significant value is 0.249 more than 0.05 which means normal distribution. Likewise, in the posttest, the significant value is 0.296 more than 0.05 which means normal distribution.

Researchers conducted a t-test (paired sample test) after calculating the normality test. The t-test is calculated with the aim of knowing whether there is an average difference between two paired samples or the same subject with different treatments (Priyanto, 2018: 147). If the sig value. (2-tailed)  $\leq 0.05$  then there is a significant difference between pretest and posttest data, while if sig. (2-tailed)  $> 0.05$  then there is no significant difference between pretest and posttest data. The results of the t-test can be seen in Table 7.

**Table 7.** T-test Results (paired sample test)

Action	N	Mean	Std. Deviation	Std. Error	Sig. (2- tailed)
Pretest	33	59.2930			
Posttest	33	78.7879	4.57439	0.79630	0.000

Based on the t-test results obtained the sig value. (2-tailed) is 0.000 where  $0.000 \leq 0.05$ . This shows that there is a noticeable difference in students before and after using Interactive Multimedia that implements Problem-Based Learning. This research is supported by Prabawa & Restami (2020) that the use of multimedia is effective enough to improve student learning outcomes. This can be seen from the acquisition of sig. (2-tailed) is 0.001 where  $0.001 \leq 0.05$  so there is a significant difference and the use of multimedia affects the quality of students.

The last test used in this study is the N-Gain test. The N-Gain test aims to determine the average increase in learning outcomes of fifth-grade students of SD N 1 Ngadirejo Temanggung on the material of the digestive system in humans.

**Table 8.** N-Gain Test Results

Action	N	Mean	Different	N-Gain	Criteria
Pretest	33	59.2930			
Posttest	33	78.7879	19.4948	0.4911	Medium

Based on table 8. The results of the large-scale trial, the average difference obtained is 19.4948 and the N-Gain results show the number 0.4911 with medium criteria. In carrying out the lesson, various factors affect the success of a lesson. One of the factors related to the use of technology-based learning media is the readiness

of students to learn. Learning will be carried out effectively if it has both physical and psychological readiness (Setiawan, 2017: 7). Students have never been directly active in learning using technology so students are still adapting and the N-Gain obtained is not optimal, which is in the medium criteria even though the learning outcomes of students, in fact, increase after using interactive multimedia based on problem-based learning.

This research is supported by research conducted by Aprianty et al. (2021), which shows that there is an increase in learning outcomes after students use interactive multimedia. This is proven effective by getting an N-Gain value of 0.65 which is categorized as medium. In conclusion, the use of interactive multimedia based on Problem-Based Learning can improve student understanding, especially in science lessons, especially on the material of the human digestive system in class V SD N 1 Ngadirejo Temanggung.

**Conclusion**

Based on the results of research conducted in class V SD N 1 Ngadirejo Temanggung, it is concluded that researchers have developed Interactive Multimedia based on Problem-Based Learning using the R&D (Research and Development) research method with the Borg and Gall development model. Interactive multimedia based on problem-based learning is made into a unit that contains text, images, sound, and video so that it can attract the attention of students. Interactive multimedia is made using the Canva application and is in the form of a link with the contents of the cover component, main menu, instructions, problem-based learning material, games, evaluations, and development profiles so that it can make it easier for anyone and anywhere to access it. Interactive multimedia has met the criteria for being very feasible to use in learning based on the validator's assessment. Media expert assessment is 93.75% with very feasible criteria and material expert assessment is 92.5% with very feasible criteria. Meanwhile, the effectiveness test obtained the N-Gain value in the large group trial of 0.4911 with medium criteria. Based on the results of the study, it can be concluded that Interactive Multimedia based on Problem-Based Learning was successfully developed, feasible, and effective to use to improve the learning outcomes of IPAS fifth-grade students on the material of the digestive system in humans.

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#### Author Contributions

Husna Maulida Adhana is the main researcher as well as the author of this article. The main researcher is in charge of collecting data, making instruments, conducting research, and analyzing research data. Aldina Eka Andriani is the second researcher in this article. She is in charge of assisting in the preparation of instruments and analyzing research data.

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#### Conflicts of Interest

The authors declare no conflict of interest.

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