# Creative-scientific decision-making skills learning model for training creative thinking skills and student decision making skills

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## ABSTRACT

**Purpose:** This study aims to produce a valid learning model by validating the creative-scientific decision -making skills (CSDMS) learning model to improve creative thinking skills and decision-making skills.

**Design/Methodology/Approach:** The research methodology is development research adapted from Borg and Gall which consists of three stages: the preliminary stage, the model design stage and the model testing stage. This research is conducted through validation study designs those tests two criteria, namely content and construct validity by involving three experts in Focus Group Discussion (FGD) activities. The validity criteria were determined based on the Aiken validation index.

**Findings:** The study's findings show that the CSDMS model is valid in terms of content and construct. This is based on calculations using the Aiken formula which shows that the V value for each instrument item is $0.89 \leq V \leq 1$ with a very valid category. It was concluded that the CSDMS model was stated to be valid both in terms of content and construct validity in order to improve students' creative thinking skills and decision-making skills.

**Contribution to literature:** This research produces a valid learning model in terms of content and construct, so that it can improve creative thinking skills and decision-making skills. The CSDMS model has a syntax consisting of six phases, namely: 1) Problem orientation 2) Exploration 3) Elaboration 4) Group investigation 5) Decision making and 6) Evaluation and reflection.

***Keywords:*** *Construct validity, Content validity, Model creative-scientific decision making skills.*

## 1. INTRODUCTION

Technology and education are undergoing rapid transformation as a result of the fourth industrial revolution (Baer, 1993). Students must be able to compete in the world of education and employment due to rapid change (Baer, 1993). Students need a variety of talents to compete in educational and employment fields. Students must possess two qualities: creativity in thought and sound judgment.

Creative thinking is a synthesis of divergent, intuition-based thinking and rational reasoning (Baer, 1993). Divergent thinking will result in a wide variety of ideas and logical thinking will establish the veracity of those ideas. Marzano, Waters, and McNulty (1998) identified five traits of creative thinking. They are as follows: (1) Desire and effort are intimately tied to creativity. (2) Creativity results in something novel. (3) For creativity, internal rather than external assessment is necessary. (4) Ideas that are not constrained are part of creativity. (5) When accomplishing something, creativity frequently manifests itself. There are four signs of creative thinking: (1) Fluency, which is the capacity to produce many ideas. (2) Flexibility, which is the capacity to produce ideas or ways that differ. (3) Originality, the capacity to come up with novel concepts that have not been thought of before. (4) The capacity to expand or supplement concepts in order to produce more in-depth and elaborate ideas (Hu & Adey, 2002). People who are creative thinkers are those who have a lot of ideas or suggestions for fixing a problem.

Making decisions is the outcome of a mental or cognitive process that involves selecting a course from among multiple viable options. Making decisions is the outcome of every person's consideration of the numerous possibilities available and selection of the most appropriate response (Santrock, 2011). The best course of action is a decision. Hence, it is important to educate every person through training so that they may subsequently make thoughtful judgments and take appropriate action to address societal issues. According to



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Boehm and Webb (2002), writing down questions, selecting options, gathering information, creating lists of pros and cons and making decisions are some of the phases in making a decision.
The truth about education is that students have not been taught how to think creatively or make decisions, especially in Indonesia (Herman et al, 2022). Students are just expected to memorize the content without having the ability to broaden their knowledge or practice making decisions. If a student is not schooled in decision-making, knowledge based on memorization would not stick in memory for very long if students were not trained in decision- making skills. As a result, pupils' creative thinking and decision-making abilities are quite low. Due to their poor decision-making and creative thinking abilities, students are unable to compete on a global scale. Due to improper deliberate training of children, their creative thinking and decision-making abilities are low. The absence of a learning model with a syntax for fostering creative thinking skills serves as an example of this.
The goal of this research is to create a revolutionary teaching and learning framework that can improve decision-making and creative thinking skills. The approach being applied is the Creative-Scientific Decision Making Skills (CSDMS) model. The researcher developed the CSDMS model by combining theoretical research with actual data from the Discussion, Exploration, Analysis and Lock-Back (DEAL) cycle model and the Problem-Based Learning (PBL) learning model. The CSDMS model was created using a transdisciplinary approach to give unique, tried-and-true and new learning models for addressing a variety of educational difficulties, including the issue of low levels of creativity and decision-making capacity. According to researchers, the learning model must incorporate a number of components, including: 1) Problem orientation 2) Creative exploration 3) Creative elaboration 4) Developing group investigations 5) Strengthening decision making 6) Evaluation and reflection. Based on the results of the synthesis of prior research, the application of the PBL model and the DEAL-cycle model is suitable for training creative thinking skills and decision-making skills.

## 2. METHOD

This study is categorized as “research and development” (R & D; short for research and development) because its aim is to create the Creative-Scientific Decision Making Skills (CSDMS) learning model as a reliable, useful and successful final product (Nieveen, McKenney, & Akker, 2006). The learning model is used to improve creative thinking and decision-making skills. This research product also develops learning tools as an operational form of the CSDMS model, namely: a syllabus, learning events units, student textbooks, student activity sheets, decision making skills instruments and creative thinking instruments.
The research design for the development of the CSDMS model included several steps, namely: (1) A preliminary study (2) Planning research (3) Design and development (4) Limited product trials (5) Revision of limited field test results (6) Extensive product testing (7) Revision of the results of the wider field test (8) Due diligence (9) Final revision of the results of the due diligence (10) Final product dissemination and implementation (Borg & Gall, 2003). To test the content and construct validity of the learning model developed using the Nieeven and Plomp (2013) development model. The stage of developing a hypothetical learning model can be seen in Figure 1.

*A. Instruments and Data Collection*

Data collection was carried out using the validation format of the CSDMS model and learning tools provided by the validator. This validation involves three validators who are in charge of reviewing, providing input and making assessments on the validation sheet through Focus Group Discussion (FGD) activities. Three validators consist of two professors and one doctor who is an expert in physics.
Boehm and Webb (2002) explained that a developed model is said to be of quality if it meets two criteria, namely: it must be valid in terms of content and valid in terms of constructs (Plomp & Nieveen, 2013). There are three types of instruments used in the validity test, namely: a) content validity of the CSDMS model b) Construct validity of the CSDMS model c) Construct the validity of learning tools that support learning the CSDMS model. Researchers used three types of validation sheet instruments as presented in Table 1.
The content validity of the model measures six aspects, namely: 1) the need for developing a CSDMS model 2) The design of the model which is empirical 3) Planning and implementation 4) Learning environment 5) Evaluation techniques 6) A final thought (Nieeven & Plomp, 2013; Plomp, 2013).



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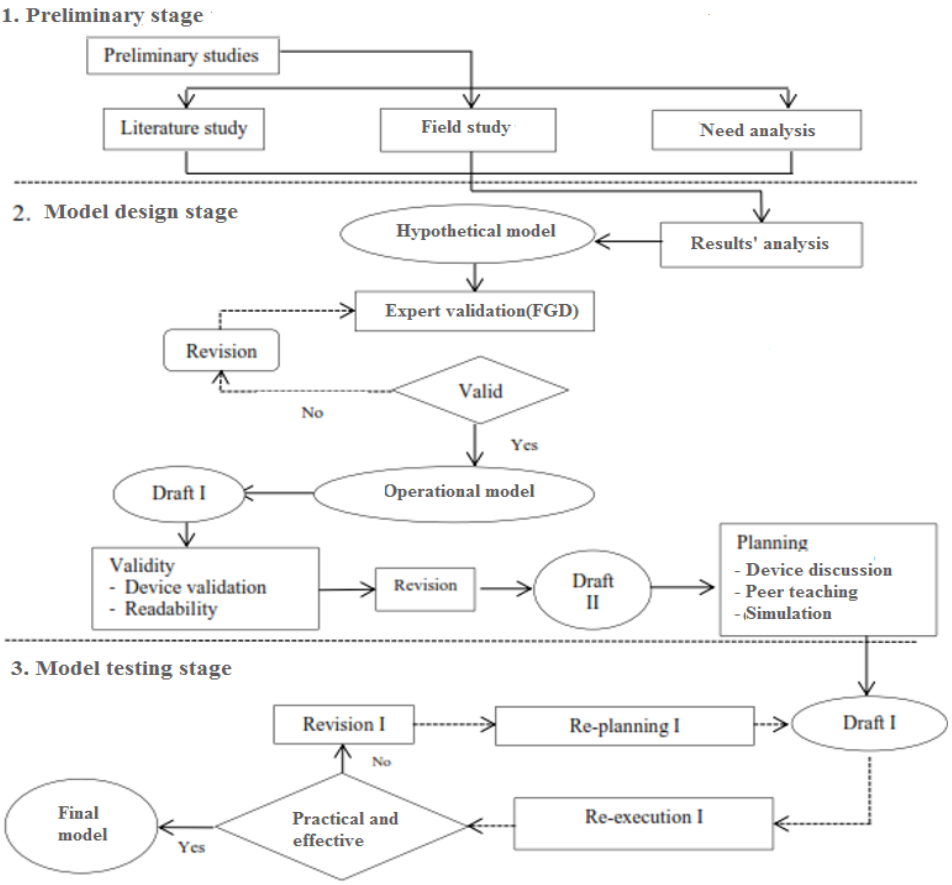


**Figure 1.** CSDMS model development stage.

**Table 1.** Instruments and components of validation aspect assessment.

| Instrument | Validity aspects |
|---|---|
| Content validity of the CSDMS learning model | (1) The need for a CSDMS learning model (2) Model design meets the renewal of knowledge (The state of the art of knowledge). |
| The construct validity of the CSDMS learning model | (1) Overview of the model (2) Theoretical and empirical support (3) Planning and implementation (4) Learning environment (5) Evaluation techniques (6) A final thought |
| Construct validity of learning devices that support the CSDMS model | a. Syllabus<br>(1) Constructed for every meeting (2) Syllabus identity (3) Syllabus table format (4) Content (5) Language |
| | b. Lesson plan<br>(1) Lesson plan identity. (2) Indonesia's National Qualifications Framework (Kerangka Kualifikasi Nasional Indonesia or abbreviated as KKNI) core competencies (3) Learning objectives (4) Learning materials (5) Learning model approaches (6) Media, tools and materials (7) Learning activities (8) Learning resources (9) Assessment |
| | c. Students' teaching materials<br>(1) Design of student books (2) Format of student textbooks (3) Language (4) Presentation (5) Innovation and quality improvement |
| | d. Students' worksheet<br>(1) Systematics of students' worksheets (2) Format of students' worksheets (3) Language (4) Presentation (5) Innovation and quality improvement |
| | E. Creative thinking instrument<br>(1) Content validity (2) Construct validity (3) Language |

**Source:** Nieeven and Plomp (2013); Plomp and Nieveen (2013).



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*B. Data Analysis*

Content validity (relevance) and construct validity (consistency) were analyzed descriptively using a qualitative statistical approach to conclude the quality of the developed model (Aiken, 1980). The validity of the CSDMS model and learning tools was assessed using a validation instrument sheet with an assessment of four scales, namely: 1) invalid. 2) Less valid. 3) Valid. 4) Very valid. Data from model validation and learning tools obtained from FGD activities were analyzed by calculating the average score for each aspect by three validators. The validity criteria are determined based on the index proposed by Aiken as follows:

$$V = \frac{\sum s}{N\,(c-1)} \qquad for\ s = r - l$$

Description: r = number given by an expert
l = the lowest validity rating score ( i.e. 1).
c = the highest validity rating score ( i.e. 4).
N = number of raters.
V = Aiken validation index.
The validity of each aspect of the CSDMS learning model and tool is determined by referring to the criteria contained in Table 2.

**Table 2.** Assessment criteria for model validation and learning tools.

| No. | Aiken validation index (*V*) | Validity level |
|---|---|---|
| 1 | 0.75 ≤ V ≤ 1 | Very valid |
| 2 | 0.50 ≤ V < 0.75 | Valid |
| 3 | 0.25 ≤ V < 0.50 | Less valid |
| 4 | 0.00 ≤ V < 0.25 | Not valid |

The reliability of the results of the assessment of the validity of the model book and learning tools is calculated using the percentage of agreement formula which is presented below:
R= [1- (A-B)/(A+B)] x 100 (Borich, 1994).
Description: R is the coefficient of reliability.
A = Valuation of the validator who gives a high score.
B = Validator rating that gives a low score.
The results of the assessment between validators are said to be reliable if the reliability value is 75% (Borich, 1994).

*C. Validation Study Results*

The CSDMS model is a learning strategy created to develop the indicators of fluency, flexibility, originality and elaboration in the development of creative thinking skills. The CSDMS paradigm contains five syntaxes, including (1) problem orientation (2) creative exploration (3) creative elaboration (4) group investigation guidance and (5) evaluation and reflection. The CSDMS model is designed by taking into account: (1) theoretical and empirical studies (2) The purpose of the developed CSDMS model (3) Learning activities (4) Learning environment (Arends, 2012; Joyce, Weil, & Calhoun, 2009). The syntax of the CSDMS model and learning activities are presented in Table 3.

## 3. RESULTS

The results of the content and construct validity of the CSDMS model can be seen in the following section:

*3.1. Content Validity*

Based on the data in Table 4, it appears that V Aiken is 0.89 V 1 with a very valid category. This shows that the CSDMS model has met needs and is state of the art (Nieveen et al., 2006). The reliability coefficient for each aspect of content validity is in the range of 86% to 100%. The reliability coefficient is in terms of 75% inter-observer agreement (Borich, 1994) so the results of the validation of the content of the developed model are reliable.



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**Table 3.** CSDMS model syntax and lecturer and student activities.

| **Lecturer's activities** | **Students' activities** |
|---|---|
| Phase I: Problem orientation | |
| 1. Giving the initial question before the question of substance.<br>2. Motivating students with research activities.<br>3. Organizing students around the problem of research activities.<br>4. Delivering cognitive, affective and psychomotor learning objectives. | 1. Listening to the lecturer's explanation and giving answers.<br>2. Observing and asking questions about the phenomena presented.<br>3. Be actively involved in learning.<br>4. Discussing the learning steps. |
| Phase II: Creative exploration | |
| 1. Describe the topic being taught.<br>2. Exploring student experiences Provide knowledge or skills needed to carry out learning in the elaboration phase.<br>3. Guiding students to raise questions<br>4. Inviting students to write down concepts, terms and theories that according to them are related to the learning topic. | 1. Listening to the lecturer's explanation<br>2. Raising questions.<br>3. Listing down concepts, terms and theories that according to the students are related to the learning topic. |
| Phase III: Creative elaboration | |
| 1. Preparing students' worksheets (Lembar Kerja Mahasiswa/LKM) and all logistics (additional reading materials other than student books or tools and materials needed if the activities are in the form of experimental activities).<br>2. Guiding students both individually and in groups in working on their worksheet (Lembar Kerja Mahasiswa/LKM).<br>3. Helping students in constructing knowledge, for example, by giving them questions that make them think (the construction process) until they can construct their knowledge correctly. | Work in groups to understand concepts, theories, terms or relationships between them with the help of the students' worksheet (Lembar Kerja Mahasiswa/LKM). |
| Phase IV: Guiding group investigations | |
| Developing student responsibility in experimental activities and reviewing various sources of information referring to the students' worksheet (Lembar Kerja Mahasiswa/LKM) to solve scientific problems creatively and be able to make decisions. | Trying to develop and study various sources of information to solve scientific problems creatively and be able to make decisions. |
| Phase V: Decision-making | |
| Giving responsibility for making decisions to students and then discussing the results of their group performance in front of the class. | Conducting analysis and discussion to determine decisions and then presenting the results of their performance in front of the class. |
| Phase VI: Evaluation and follow-up | |
| Involving students in evaluating their creative thinking skills, making decisions and follow-up. | Participating in the evaluation of creative thinking skills, making decisions and their follow-up. |

*3.2. Construct Validity*

Based on the data in Table 5, it can be seen that V Aiken is 0.89 V 1 with a very valid category. This shows that the CSDMS model meets the consistency requirements between the components that make up the model (Nieveen et al., 2006). The reliability coefficient for each aspect of content validity is in the range of 86% to 100%. The reliability coefficient is within the provisions of the 75% inter-observer agreement (Borich, 1994) so the results of the validation of the developed model construct are reliable.



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**Table 4.** CSDMS model content validity assessment results.

| No | Assessment aspect | Validator | | | M | Validity coefficient | | | | | | Reability | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | I | II | III | | S1 | S2 | S3 | ΣS | *V* | Description | Koef R | Description |
| a | CSDMS model development needs | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 9 | 1.00 | SV | 100 | R |
| b | Model design meets knowledge renewal (State of the art of knowledge) | 4 | 3 | 4 | 4 | 3 | 2 | 3 | 8 | 0.89 | SV | 86 | R |

**Table 5.** CSDMS model construct validity assessment results.

| No | Assessment aspect | Validator | | | M | Validity coefficient | | | | | | Reability | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | I | II | III | | S1 | S2 | S3 | ΣS | *V* | Desccription | Koef R | Description |
| a | Model overview | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 9 | 1.00 | SV | 100 | R |
| b | Theoretical and empirical support | 4 | 3 | 4 | 4 | 3 | 2 | 3 | 8 | 0.89 | SV | 86 | R |
| c | Planning and implementation | 3 | 4 | 4 | 4 | 2 | 3 | 3 | 8 | 0.89 | SV | 86 | R |
| d | Learning environment | 3 | 4 | 4 | 4 | 3 | 2 | 3 | 8 | 0.89 | SV | 86 | R |
| e | Evaluation technique | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 9 | 1.00 | SV | 100 | R |
| f | A final thought | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 9 | 1.00 | SV | 100 | R |

*3.3. Results of the Validity of the CSDMS Model Learning Tool*

Table 6 shows that V Aiken is 0.89 V 1 with a very valid category. The reliability coefficient for each aspect of content validity is in the range of 100%. The reliability coefficient is in the inter-observer agreement provisions of 75% so that the results of the validation of the developed syllabus are reliable.

**Table 6.** CSDMS model construct validity assessment results.

| No | Assessment aspect | Validator | | | M | Validity coefficient | | | | | | Reability | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | I | II | III | | S1 | S2 | S3 | ΣS | *V* | Description | Koef R | Description |
| a | Syllabus | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 9 | 1.00 | SV | 100 | R |
| b | Learning event unit | 4 | 3 | 4 | 4 | 3 | 2 | 3 | 8 | 0.89 | SV | 86 | R |
| c | Student teaching materials | 3 | 4 | 4 | 4 | 2 | 3 | 3 | 8 | 0.89 | SV | 86 | R |
| d | Student worksheet | 3 | 4 | 4 | 4 | 3 | 2 | 3 | 8 | 0.89 | SV | 86 | R |
| e | Creative thinking skills test | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 9 | 1.00 | SV | 100 | R |
| f | Syllabus | 4 | 4 | 4 | 4 | 3 | 3 | 3 | 9 | 1.00 | SV | 100 | R |

## 4. DISCUSSION

*4.1. Content Validity*

The data on the results of the content validity of the CSDMS model are presented in Table 4 which shows the assessment of experts with very valid criteria to improve creative thinking skills and decision-making skills



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because they meet expected validity and actual validity (Nieeven & Plomp, 2013). The expected validity states that experts agree that the CSDMS model is very valid and reliable in content because it is designed according to the needs of model development, elements of state of art knowledge, theoretical support and the learning environment. Actual validity is the application of the CSDMS model at the model testing stage which can significantly improve creative thinking skills and decision-making skills. This is in line with the opinion from (Arends, 2012) which states that a valid learning model must be able to direct the achievement of certain competencies, so that a valid model can help lecturers and researchers in designing learning. This means that it is constructed from appropriate learning principles (Seechaliao, Natakuatoong, & Wannasuphoprasit, 2012).

*4.2. Construct Validity*

Table 5 presents the data from the construct validity findings of the CSDMS model, which illustrates the expert's evaluation using very valid and reliable standards. Using a validation sheet with question items that can be traced through the model book, the construct validity of the CSDMS model is assessed. The construct validity is declared very valid. This means that the CSDMS model has shown consistency between its components which include the efforts of the model, theoretical and empirical support, planning and implementation of the model, the learning environment, evaluation techniques and a final thought about the model.

The syntactic order of the CSDMS model reflects the logic of thinking in the development of decision-making and creative thinking skills. A small experiment was conducted to examine the syntax of the CSDMS model, and the findings revealed consistency between the model's elements in achieving educational objectives. According to Nieveen et al. (2006), a learning model's validity is determined by whether or not it satisfies the standards for valid content and structures. This indicates that a limited scale test and a wider trial of the CSDMS model are both feasible. In order for a teaching strategy to assist students in acquiring knowledge, skills, values and creative outlets (Joyce et al., 2009).

*4.3. Validity of the CSDMS Model Learning Tools*

The validity of the CSDMS model learning tools is shown in Table 6 which includes the syllabus, learning events units, student teaching materials, student activity sheets, the creative thinking skills test and the decision making skills test. The device was validated by three validators. Data validation of the CSDMS model device shows that the syllabus, learning program unit, student teaching materials, student activity sheets, and creative thinking skills test and decision making skills test with very valid and reliable criteria. Based on these results, it can be stated that the developed device is capable and can be used as a reference or guide by lecturers in supporting learning in class with the CSDMS model. This is in line with the opinion (Gravemeijer & Cobb, 2006) which states that validation is carried out to see the suitability of theories related to learning activities, learning steps and how to teach well.

The FGD activities carried out by experts providing suggestions and input on the CSDMS model tool section are as follows:

1. Syllabus: a) the writing of the department should be a faculty in the identity aspect of the syllabus; b) basic competencies must refer to creative thinking skills and decision-making skills.
2. Learning Program Units: a) learning objectives use the ABCD format where A = audience, B = behavior, C = condition, D = degree; b) indicators in the syllabus must be consistent with those in the lesson plan (Satuan Acara Perkuliahan or abbreviated as SAP).
3. Student Teaching Materials: a) need to make a cover, table of contents, introduction and summary. b) In competency tests, learning indicators and creativity tests, creative thinking skills and decision-making skills should be trained. c) The use of formula derivation should be made clearer.
4. Student worksheets must measure creative thinking skills and decision-making skills.
5. Instruments: a) the instruments made must be in accordance with the indicators of creative thinking skills and the creative thinking skills test, the criteria are very valid and reliable. b) Questions about magnetic materials should be made.

The suggestions given by the validator are corrected by the researcher and the results of the improvements are submitted back to the validator.

Based on the findings regarding the validity of the learning tools, it can be concluded that the CSDMS model learning tools are very valid as supporters of basic physics learning tools for universities. Learning planning involves time allocation, choosing the right method, creating interest in learning and building a productive learning environment (Arends, 2012). Quality learning tools make it easier for lecturers to interact with



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students, facilitate interaction between students and students to learn and provide support in practicing creative thinking skills and decision-making skills in accordance with the demands of 21st -century skills.

## 5. CONCLUSION

The CSDMS model had a V Aiken of 0.89 V 1 with a very high category and it was determined from the study's findings that it was valid in terms of content, constructs and supporting tools for practicing creative thinking skills and testing decision-making skills with very valid and reliable criteria. Valid and the reliability coefficient is 85 R 100, demonstrating the dependability of the developed validity results. The CSDMS model created by this study has six syntaxes: problem orientation, creative exploration, creative elaboration, directing group investigations, decision making, evaluation and reflection. To introduce and follow up on research findings as a reference for model improvement, the CSDMS learning model must be made available to teachers and lecturers.

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The authors declare that they have no competing interests.

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**AUTHORS' CONTRIBUTIONS**
All authors contributed equally to the conception and design of the study.



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