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DEVELOPMENT OF A DIGITAL POP-UP BOOK SCIENCE TEACHING MATERIAL TO INCREASE ACTIVITY AND RETENTION OF JUNIOR HIGH SCHOOL STUDENTS

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Abstract

This study aims to assess the feasibility (validity, practicality, effectiveness) of digital pop-up book model science teaching materials, and increase the activity and retention of 8th-grade students of SMP Negeri 3 Bungku through the application of digital pop-up book model science teaching materials. This research is an ADDIE model development research developed by Branson, including the stages of analysis, design, development, implementation, and evaluation. The variables in the study were digital pop-up book model science teaching materials, activity and retention of students. The population in this study were all students in class VIII of SMP Negeri 3 Bungku in the 2023/2024 academic year, while the sample was class VIIIB students. Research data were obtained through observation, interviews, questionnaires, and tests. The results showed that this teaching material is suitable for use in learning. The assessment given by three validators on the content and media aspects amounted to 94.4% and 87.5% with very valid criteria. The responses obtained from teachers and students showed a percentage of 93.3% and 90% with very practical criteria. This teaching material is effective to use in learning because it has a small effect on 4 learners and a moderate effect on 11 learners in small groups. The application of this teaching material in the treatment class has increased learning activities and of student retention.

Keywords: Teaching materials, pop up book, activity, retention.

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Introduction

Learning in the classroom is the spearhead of all educational activities carried out by teachers. The teacher's ability in learning is an absolute requirement that must be met to improve the quality of learning. Meanwhile, the success of students' learning is largely determined by students' activities in the learning process created by the teacher. In science learning, teachers must utilize various learning facilities and resources to encourage students to be more active and make learning science fun. According to Irfan *et al.* (2019) a teacher is required to be able to create a learning atmosphere that suits the character of the students and the character of the material delivered in the form of a learning model equipped with learning resources and supporting media.

A good learning atmosphere supports the implementation of effective learning. Effective learning according to Muslim *et al.* (2001) can be seen from the dimensions of teachers and students. From the teacher dimension, in the teaching and learning process teachers are active in monitoring students' learning activities, providing feedback, asking challenging questions, questioning students' ideas, teachers must be creative in developing various activities, creating learning aids or media. Effective learning supports the achievement of learning goals. In order for learning objectives to be achieved, teachers must be able to package the material so that it is easier for students to understand, use learning methods that can attract students' attention and are appropriate to the material. From the student dimension, students must be active in asking questions, putting forward ideas, questioning other people's ideas and ideas, students are creative in writing or summarizing, designing or making something and finding something new for themselves, students' effectiveness can be seen from mastery of the skills needed by students, fun learning can make students dare to try or act, dare to ask questions, dare to express ideas, dare to question other people's ideas.

Based on observations in Class VIII of SMP Negeri 3 Bungku and interviews with Class VIII science teachers, it shows that students are passive during the learning process and get bored easily, which has an impact on achieving learning objectives. In the learning process the teacher tries to use media, in this case printed teaching materials and occasionally uses Canva. The teaching materials that have been used in learning have a sequence of presentation that does not attract the attention and interest of students. Especially for science lessons, students recognize it as a subject that is difficult to understand because it has many rote and abstract concepts. The use of Canva is also not effective in stimulating student activity, because it is still

centered on the teacher in delivering the material. Lack of attention, interest and activity of students has an impact on the low achievement of learning completion.

Learning mastery is closely related to retention factors. Students who have good study habits, such as repeating material regularly, taking notes, or having group discussions, tend to have better memory. Therefore, it is important to create a supportive learning environment so that students can retain information better.

The retention factor or the stickiness of concepts in memory still receives little attention even though it can be used as an indicator of the quality of learning or learning outcomes (Juniarsih *et al.*, 2015). In reality, many things that have been stored in memory are difficult to reproduce, this is known as forgetting (Antika *et al.*, 2013). Science learning should be designed well so that students do not feel that science is synonymous with memorization. Meaningful learning will be able to maintain student retention so that concepts will not quickly disappear in students' memories. Learning that is able to actively engage students and increase retention requires appropriate learning tools. Strong retention means that what students know will be stored in memory and will make it easier for brain cells to connect with each other. Students who have weak retention can have a negative impact on their learning outcomes in learning (Lubis *et al.*, 2010).

Students' understanding of the material can be improved if the learning process is supported by learning resources (Hayati *et al.*, 2015). One form of this learning resource is teaching materials. Wahyudi (2022) states that educators and students need teaching materials to help with teaching and learning activities. Teaching materials are a set of material that is arranged systematically, presenting a complete figure of competencies that will be mastered by students in learning activities (Dick & Carey, 2009). Teaching materials are a means for teachers and students to understand learning material (Agung *et al.*, 2021). Meanwhile, according to Indariani (2018), teaching materials are an important element in the implementation of learning, both written and unwritten, which are arranged systematically and can be in the form of textbooks, handout modules, worksheets and other types of teaching materials which are currently widely used in various schools. Basically, teaching materials must be relevant to the learning objectives and needs of students.

The relevance of teaching materials will have an impact on student learning outcomes. Developing teaching materials that suit students' needs and environment is an effort to increase their participation in learning, with the hope that the concepts studied will be easier to understand and remember. According to Magdalena *et al.* (2020) the development of teaching materials is very helpful and influences many things starting from students being more active in learning, students enjoying lessons without feeling bored, and making it easier for students to understand the material being taught. We often come across a number of learning materials that students find difficult to understand and it is possible that teachers will find it difficult to explain them. These difficulties may occur because the material is abstract, complicated, foreign, and so on. To overcome this difficulty, it is necessary to develop appropriate teaching materials. If the learning material to be delivered is abstract, then the teaching material must be able to help students describe something abstract, for example by using pictures, photos, charts, schemes and so on.

Students can be stimulated to understand something abstract, one of which is by developing model teaching materials pop-up book. Dewanti *et al.* (2018) stated that utilization pop up book It has benefits in developing children's creativity, stimulating imagination and fostering children's interest in reading because of its deep shapes and colors pop up book can attract attention to learning.

Along with the development of time, science and technology, model teaching materials pop-up book can be made in digital form through software *power point*. Making teaching materials pop-up book digitally with an interesting concept that is seen as practical and creative so that it can foster students' enthusiasm and motivation in learning (Habibi *et al.*, 2022). Digital technology is also believed to increase retention (*retention*) and persistence (*persistence*) learning in students and can also provide rich content (*rich content*) and is more suitable to be applied in 21st century learning models (Mawarni *et al.*, 2017). Teaching materials pop up book This digital base can be accessed via smartphone so it is considered practical because it can be used anywhere and for a long period of time. Apart from that, the facts that occur in schools show that in general students cannot be separated from use smartphone.

Based on the description above, researchers are interested in conducting research on the development of model science teaching materials pop up book digital to increase student activity and retention in class VIII SMP Negeri 3 Bungku.

Methods

This research is development research which aims to develop natural science teaching materials on the human respiratory system using the ADDIE model, which consists of five stages: analysis, design, development, implementation, and evaluation. This research was carried out at SMP Negeri 3 Bungku, which is located on Jln. Production in Ipi Village, Bungku Tengah District,

Morowali Regency, Central Sulawesi Province, from November 2023 to June 2024. The research population includes 88 students in class VIII of SMP Negeri 3 Bungku for the 2023/2024 academic year, with the research sample being class VIII B, totaling 30 people, consisting of 20 men and 10 women with an average age of 13.16 years. The sampling technique used is purposive sampling.

Level *Analysis* involves analyzing needs, facilities and materials to determine learning conditions, supporting factors and material that will be featured in teaching materials. Stage *Design* includes designing teaching materials by setting learning objectives, creating content description scripts, determining supporting images, and preparing sound recordings for audio. Stage *Development* realizing products using applications Microsoft PowerPoint version 365 and Capcut and conduct feasibility tests on teaching materials (validity, practicality and effectiveness). The effectiveness test of teaching materials was carried out at two meetings, namely after students learned using printed teaching materials and after using digital pop-up book teaching materials. Next, the evaluation is based on corrections and assessments from validators, teachers and students. Stage *Implementation* implement teaching materials in treatment classes to increase student activity and retention by design *one group pretest-posttest*. This stage took place in six meetings. The first learning meeting used printed teaching materials on the human respiratory system which began with a pre-test and ended with a post-test. The second meeting was retested. The third learning meeting uses teaching materials pop-up book digital part 1 discusses the organs in the human respiratory system, starting with a pre test. The fourth learning meeting uses teaching materials pop-up book digital part 2 discusses the mechanisms of human breathing. The fifth learning meeting uses teaching materials pop-up book digital part 3 discusses disorders and efforts to maintain the health of the human respiratory system and ends with a post test. The sixth meeting was retested. Stage *Evaluation* includes formative evaluation during the development process to obtain feedback, and summative evaluation after the teaching materials are used to assess the overall success of development.

Data collection techniques used include interviews to obtain information from science subject teachers, validation to determine the validity of teaching materials, surveys of students in small groups to determine the practicality and effectiveness of teaching materials, observations to collect information about learning situations and obstacles and assessing activities. student learning, written tests to measure student retention after studying the material, and literature studies to collect related theoretical information. The assessment instruments prepared for the development of teaching materials include several important components. First, a validation questionnaire for teaching materials which includes aspects of content and media (face). The content validation questionnaire consists of 12 statements, while the media validation includes 16 statements. This questionnaire is closed with a rating scale of 5, where validators are asked to provide an assessment with a checklist (√) on the appropriate scale. Furthermore, response questionnaires consist of two types: teacher response questionnaires which contain 12 statements and student response questionnaires which contain 10 statements. These two questionnaires are also closed, teachers and students are asked to respond with a checklist (√) in the yes or no column. Apart from that, the student learning motivation questionnaire consists of 10 positive statements and 15 negative statements. This questionnaire is equipped with a 5 rating scale and is closed. To measure students' learning activities, an observation sheet is prepared which includes 6 types of activities: visual, oral, listening, metric, mental and emotional. Observers are given three assessment options and are selected by giving a checklist mark (√).

Finally, to measure student retention, questions were prepared in the form of 20 multiple choice questions which were used for the pre-test, post-test and retest. Each correct answer is given a score of 5. All of these instruments are designed to ensure that validity, response, motivation, activity and retention of students can be measured well in the process of developing teaching materials. Test the effectiveness of product implementation using data analysis techniques effect size according to Cohen (1988) which is a measure of the strength and weakness of an independent variable and a dependent variable.

Results and Discussion

Model IPA teaching materials pop-up book digital was developed using the method *research and development* (R & D) with the ADDIE model developed by Branson (1975). The ADDIE development model consists of 5 (five) steps, namely analyze, design, development, implementation, and evaluation.

Analysis

The analysis stage is the stage where researchers analyze the need for developing teaching materials. The analysis stages carried out are needs analysis, facilities analysis and material analysis.

Needs Analysis

Needs analysis is the initial stage in the development stage which is carried out by learning observations and interviews. By analyzing the need for teaching materials,

researchers can find out the causes of the gap between learning materials and competencies.

1) Classroom learning observations and student observations

Observations of learning and student observations were carried out in class VIII B of SMP Negeri 3 Bungku. Aspects observed include learning tools, learning processes and student behavior. For learning tools, look at the availability of the syllabus and RPP. In the learning process, the activities of opening and closing the lesson, presentation of material, methods used, use of language and time, student movements, ways of motivating, questioning techniques, class mastery, use of media, and forms of evaluation are observed. Meanwhile, for the behavioral aspect, students' behavior in the classroom and outside the classroom is observed. From the observations made, it appears that the use of teaching materials by students in the form of printed science books is still very lacking. Most students do not pay attention and read the contents of books, and do not use books when given assignments. Apart from that, there are still many students who are passive in learning activities, embarrassed to ask, answer or express opinions. This will have an impact on students' ability to understand the lesson material.

2) Interview

Interviews were conducted with resource teachers in science subjects in class VIII of SMP Negeri 3 Bungku. Interview topics include student characteristics, curriculum, and teaching materials. The topic of student characteristics includes questions regarding the total number of students in class VIII, student learning outcomes, learning activities, problems that often arise, and character that needs to be improved. On the curriculum topic, questions are asked about learning methods that are often applied, problems regarding the curriculum, and themes that require the development of teaching materials. Meanwhile, on the topic of teaching materials, questions include the availability of teaching materials, intensity of use of teaching materials, and problems that often arise and their expectations. From the interviews conducted, it is known that there are several obstacles faced by teachers in classroom learning. Among these are students' learning outcomes which are still low in certain materials, especially abstract materials. Students also get bored easily when the teacher is explaining, are not serious when asked to read a book, are not focused, are less active during discussions, and lack discipline in doing assignments. Therefore, teachers hope that there will be efforts to increase students' interest, concentration, activeness, and ability to understand the material, so that learning objectives can be achieved.

Teaching materials as something that is very important in learning must be interesting and easy for students to understand, so that students feel that learning at school is not a burden for them. Interesting teaching materials will motivate students to learn. One model that is interesting and can be applied in developing teaching materials is a model pop-up book digital. The teaching materials currently used in schools are printed books published by the Ministry of Education and Culture.

Facility Analysis

The facilities owned by the school greatly influence the level of success of the product to be developed. To support learning with digital media, SMP Negeri 3 Bungku has been equipped with an internet connection that can be accessed for free by students. Apart from that, there are also devices *headset* available in the computer laboratory. And the most important thing is the availability of smartphones for the majority of students.

Material Analysis

The material on the human respiratory system includes structure, function, mechanisms, and disturbances that can occur in this system. The structure of the respiratory system consists of the upper respiratory tract (nose, pharynx, larynx), lower respiratory tract (trachea, bronchi, bronchioles, lungs), and the main organs (lungs) which are responsible for gas exchange. The main function of this system is to provide oxygen to the body and remove carbon dioxide through the process of inspiration and expiration, where gas exchange occurs in the alveoli. The health of the respiratory system is influenced by living habits, environment, and genetic factors, with smoking, pollution, and exposure to harmful substances as the main causes of damage. Diseases such as asthma, bronchitis and COPD can limit daily activities and be life threatening if not treated properly. Efforts to maintain a healthy respiratory system can be done by avoiding harmful substances, maintaining a clean environment, and exercising regularly to strengthen respiratory muscles and increase lung capacity.

Design

After passing the analysis stage, the researcher created a design for the teaching material development product according to the results of the analysis carried out previously. The product design stage is carried out using several processes, namely setting learning objectives, designing the concept of teaching materials by creating content description scripts, determining supporting images for each display, and preparing instruments.

Setting Learning Goals

Based on the selected material, namely the human respiratory system, basic competencies and indicators are

formulated as benchmarks for learning objectives. Next, learning objectives are set, that through the use of digital pop-up book teaching materials, students are expected to be able to:

1) Explain the meaning of breathing
2) Name the organs that make up the human respiratory system
3) Analyze the parts and functions of organs in the human respiratory system
4) Differentiate the process of chest breathing from abdominal breathing
5) Describe the factors that influence respiratory frequency
6) Explain the various types of breathing air
7) Explain disorders of the human respiratory system
8) Explain efforts to maintain the health of the human respiratory system
9) Make a poster about efforts to maintain a healthy respiratory system

Designing the concept of teaching materials

Developing innovative and interesting teaching materials is the key to increasing student interest and learning outcomes. Concept of science teaching materials with methods pop-up book offers an engaging visual approach and can help students understand complex concepts more easily. Of the 9 (nine) learning objectives that have been determined, they will be divided into 3 (three) parts of teaching materials pop-up book digital. The first part discusses the organs that make up the human respiratory system, the second part discusses the mechanisms of human breathing, and the third part discusses disorders and efforts to maintain the health of the human respiratory system.

The researcher then collected material from various sources, both books and the internet, which was continued by creating a content description script and determining supporting images for each display. Complete the presentation of teaching materials pop-up book In this case, the author prepares a sound recording (audio) containing material that is in accordance with the content description script that has been created. This sound recording is one of the supporting components of the teaching materials that will be developed.

Instrument Preparation

After the script describing the content of the teaching materials has been completed, the next stage is that the researcher prepares the instruments that will be used to assess the teaching materials being developed. The instrument was prepared by taking into account aspects of teaching material assessment, namely aspects of feasibility, practicality and effectiveness. For the feasibility aspect, content validation and media validation instruments were prepared. For the practical aspect, an instrument was prepared in the form of a teacher and student response questionnaire. Next, for effectiveness, a learning motivation observation sheet is prepared. Increasing learning activities is measured using learning activity observation sheets, while increasing retention uses post test and retest questions. The instruments that have been prepared are validated first by experts before being used for data collection.

Development

Teaching material qualification test pop-up book digital

At this level, product teaching materials pop-up book digital and validation instruments that have been created in the previous stage are handed over to the validator, which in this case is an expert lecturer. Validators are asked to provide an assessment of the teaching materials developed based on aspects of the suitability of the teaching materials, as well as provide suggestions and comments regarding the content and media of the teaching materials, which will later be used as a benchmark for improving and perfecting the teaching materials. At this stage, the researcher also carried out data analysis on the results of the teaching material assessment obtained from the validator. This is done to obtain the validity value of the teaching materials.

1) Content expert validation

Evaluation by content experts on teaching material products pop-up book digital can be seen in Table 1.

Table 1. Content expert validation results

No	Rated aspect	Validator Assessment Score		
		In 1	V2	V3
1.	Accuracy of the title of the material with the content of the material	5	5	5
2.	Clarity of description of teaching materials	5	5	4
3.	Clarity of basic competencies and indicators	5	5	5
4.	Clarity of learning objectives	5	5	5
5.	Operational learning objectives	5	5	5
6.	Conformity between learning objectives and descriptions of teaching materials	5	5	5
7.	Clarity of description of teaching materials	5	5	4
8.	Correspondence between practice questions and teaching material	4	5	4
9.	Suitability between images/illustrations and teaching materials	5	5	5
10.	Match between student activities and teaching materials	4	5	4
11.	The accuracy of writing a bibliography that can be used as a reference for finding reading sources that are relevant to the teaching material	4	5	4
12.	Conformity between the glossary and teaching materials	4	5	4
	Total score	56	60	54
	Total Number of scores		170	
	Maximum Value		180	
	Percentage		94.4 %	
	Criteria		Very Valid	

Based on Table 1, the validation results from the three validators obtained a percentage of 94.4% with a very valid category.

2) Media expert validation

The results of the evaluation by members of the media on teaching material products pop-up book digital can be seen in Table 2.

Table 2. Media expert validation results

No	Rated aspect		Evaluation Score		
			In 1	In 2	V3
1.	Cover	Cover image accuracy	5	5	4
		Cover image quality	5	4	4
		Cover image size accuracy	5	5	4
		Cover image placement accuracy	5	4	4
		The quality of the text of the title of the teaching material	5	4	4
		Appropriate font size in the title of teaching materials	5	5	3
		Appropriate placement of teaching material titles	5	5	3
		Letter color matching	5	4	4
		Match between letters, titles and images	5	5	4
2.	Material	Suitability between the material and media used	5	4	4
		The quality of the images used	5	5	4
		Image size accuracy	5	5	4
		Accuracy of image placement	5	4	4
		Text quality in teaching materials	5	5	4
		Sound quality in teaching materials	5	5	4
		Consistency of letter size in teaching materials	5	5	4
	Total score		80	74	56
	Total Number of Scores		210		
	Maximum Score		240		
	Percentage		87.5 %		
	Criteria		Very Valid		

Based on Table 2, the validation results from the three validators obtained a percentage of 87.5% with a very valid category.

Practicality test of teaching materials *pop up book* digital

1) Teacher Response

Results of teacher responses to teaching materials pop-up book digital can be seen in Table 3.

Table 3. Results of teacher responses to teaching materials pop-up book digital.

No	Statement	S Teacher Response	
		Answer Yes	Score
1	Teaching material format pop-up book digital is immutable	2	2
2	The preparation of the material is easy to understand	2	2
3	Presentation of interesting teaching materials	2	2
4	Presentation of unique teaching materials	2	2
5	Readability of text contained in teaching materials	1	1
6	The size and shape of the letters are appropriate	1	1
7	The form of presentation is interesting to read and listen to	2	2
8	Pictures presented in teaching materials pop-up book digital is suitable and can arouse interest	2	2
9	Color of teaching materials pop-up book interesting digital	2	2
10	Every element in the teaching material pop-up book digital is presented clearly.	2	2
11	Every element in the teaching material pop-up book digital has integration	2	2
12	Shapes or patterns presented in teaching materials pop-up book digital has balance	2	2
	Total score from respondents	22	22
	Total Shoes Ideal	24	24
	Percentage (%)	91.6	
	Criteria	Very Practical	

The results of the response questionnaire from 2 science teachers at SMP Negeri 3 Bungku showed a percentage of 91.6% in the very practical category.

2) Student response

The student response questionnaire is filled out by students in small groups after using the teaching materials pop-up book digital. The students consisted of 5 people with high learning achievements, 5 people with medium learning achievements, and 5 people with low learning achievements. The results of student responses can be seen in Table 4.

Table 4. Results of student responses to teaching materials *pop up book* digital

Aspect	Statement	S Response	
		Answer Yes	Score
Convenience	1. Teaching materials pop-up book digital is easy for me to use via cellphone or laptop	15	15
	2. I can easily understand the content of the teaching material pop-up book digital because the material content is simple and practical	9	9
Continuity	3. The material presented starts from easy to more difficult levels.	13	13
	4. I easily understand the material because it relates to everyday life	13	13
Design	5. I enjoy learning using teaching materials pop-up book digital because the color of the book is attractive.	15	15
	6. I can easily understand the contents of the book because the type and size of the letters are appropriate, and the audio is clear.	12	12

	7. The picture illustrations really helped me understand the material.	10	10
Interest	8. Teaching materials pop-up book digital can help you learn material about the Human Respiratory System in a more enjoyable way	15	15
	9. It is easier for me to understand the material on the Human Respiratory System by using teaching materials pop-up book digital	12	12
	10. I am more enthusiastic about studying the Human Respiratory System material using teaching materials pop-up book digital	15	15
Total score from respondents		129	
Total Shoes Ideal		150	
Percentage (%)		86	
Criteria		Very Practical	

The results of the response questionnaire for 15 students in small groups showed a percentage of 86% in the very practical category.

Test the effectiveness of teaching materials *Pop up book* digital

Test data on the effectiveness of teaching materials pop-up book digital data obtained through a student learning motivation questionnaire in small groups. Average value *pretest* Students' learning motivation ranges from 1.84 to 2.80, while the average value *post test* ranged from 3.52 to 4.00. Standard deviation *pretest* varies from 0.49 to 0.90, while the standard deviation *post test* varies from 0.52 to 0.81. Calculation Effect Size shows that teaching materials pop-up book digital had a small influence on the learning motivation of 4 students and a moderate influence on the learning motivation of 11 students. From these results it can be concluded that teaching materials pop-up book digital has a significant positive influence on the learning motivation of most students in small groups.

Implementation

Teaching materials pop-up book digital materials that have met the eligibility criteria, namely valid, practical and effective, are then used in learning activities for 30 students in the treatment class, namely class VIII B, SMP Negeri 3 Bungku, to increase student activity and retention.

Increasing Student Learning Activities

Student activity is measured at the first meeting where students are still using printed teaching materials. From the third meeting to the fifth meeting, student activity was measured when they had used teaching materials pop-up book digital.

Observation data on student activities can be seen in Figure 1.

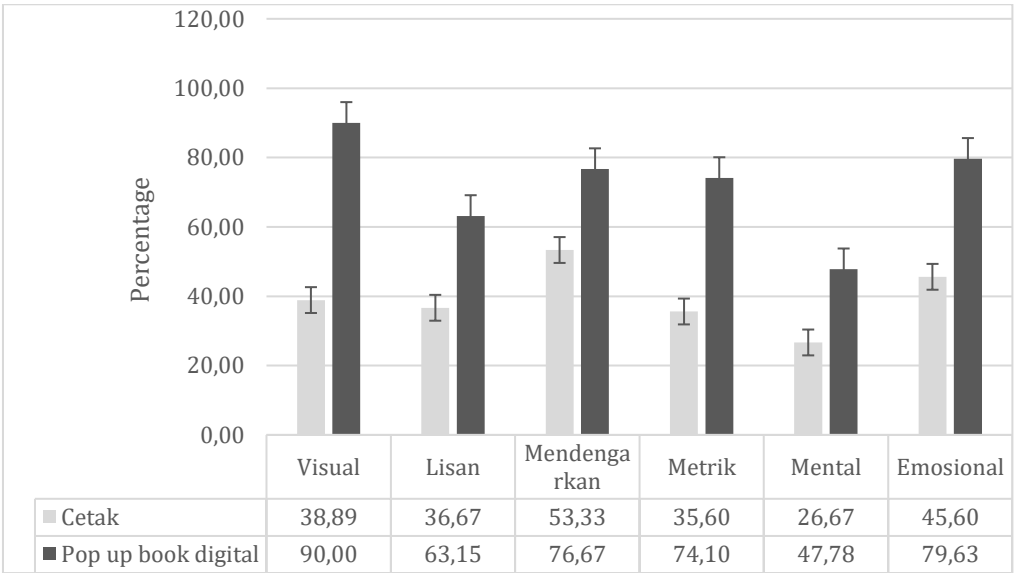

Figure 1. Student learning activity data

Figure 1 shows that there was an increase after using teaching materials pop-up book digital. When using printed teaching materials, the percentage of visual activity indicators achieved was 38.89% (failed) of all students, verbal 36.67% (failed), listening 53.33% (poor), metric 35.60% (failed), mental 26.67% (failed) and emotional 45.60% (poor). Meanwhile, during learning using teaching materials pop-up book digital, the percentage of achievement of activity indicators increases. The percentage of visual activity was 90% (very good), verbal 63.15% (fair), listening 76.67% (good), metric 74.10% (good), mental 47.78% (poor) and emotional 79. 63% (good).

Analysis of the influence given by teaching materials pop-up book digital on student activities shows that teaching materials pop-up book digital had a small influence on 7 students and a moderate influence on 23 students. From the results of this analysis, it can be concluded that teaching materials pop-up book digital has varying effects but generally has a significant positive impact on students' learning activities.

Increasing student retention

Retention data for 30 students was obtained through administering multiple choice objective tests. To measure student retention, data is needed *post test* and *retest*. Initial retention power is measured using value *post test* and *retest* when using printed teaching materials. Meanwhile, the final retention power is measured using value *post test* and *retest* when using teaching materials pop-up book digital. A comparison of the retention power of the two teaching materials can be seen in Figure 2.

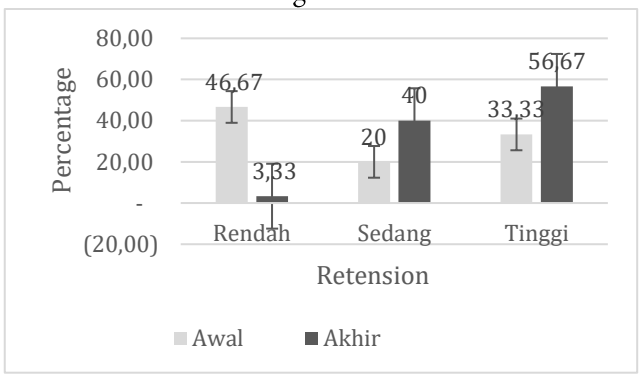

Figure 2. Retention power comparison

Figure 2 shows that when learning uses printed teaching materials, students who have low retention power are 46.67%, medium retention power is 20% and high retention power is 33.33%. Meanwhile, when learning using teaching materials pop-up book digital, students who have low retention power are 3.33%, medium retention power is 40%, and high retention power is 56.67%. It can be concluded that there is a decrease in the percentage of students who have low retention power, and there is an increase in the percentage of students who have medium and high retention power.

The results of the effectiveness value analysis show that the teaching materials pop-up book digital had a moderate influence on 29 students, and a small influence on 1 student.

Evaluation

The evaluation referred to in the ADDIE stage is formative evaluation and summative evaluation. Through formative evaluation, assessments and input are obtained from validators to improve teaching materials pop-up book digital. Even though the assessment given shows that the criteria are very valid, there are several suggestions given, including the suitability of running text with audio, and improvements to the way of writing terms.

The summative evaluation stage involves assessing the achievement of learning objectives, increasing activity, and increasing student retention.

a) At the first meeting, assess *pretest* students range from 10-35. After using printed teaching materials, assess *post-test* increased to 20-60, but still did not reach the minimum completeness criteria (KKM), namely 75. When using teaching materials pop-up book digital, value *pretest* ranges between 15-55 and value *post-test* between 55-95, with 14 students reaching KKM. This shows an increase in achieving learning objectives.
b) The increase in student activity was also evaluated and showed that all activity indicators increased after using teaching materials pop-up book digital. The largest increase occurred in visual indicators, while the smallest increase occurred in mental indicators.
c) Evaluation also includes increasing student retention. Calculation of retention power shows a decrease in the percentage of students with low retention power and an increase in the percentage of students with medium and high retention power after using teaching materials pop-up book digital.

Based on class observations, it was found that science textbooks were underutilized in learning. The books were just placed on the table without being read. When asked to read by the teacher, students do it in a disorderly manner. At first, students still paid attention to the teacher's explanation, but then they lost focus, some looked sleepy, busy themselves, telling stories, joking, and even disturbing their friends. This boredom causes them to look for other activities, which has a negative impact on their learning outcomes. To follow up on the results of observations, interviews were conducted with class VIII science teachers. The teacher revealed that one of the problems in learning is the need for learning resources or teaching materials. The teaching materials used daily, namely books from the Ministry of Education and Culture which are available in libraries, over time cause boredom among students. Even though they sometimes use Canva media, students still have difficulty understanding the material and the class atmosphere is still not conducive.

Analysis of school facilities shows that although many students use Android cellphones, these devices have not been utilized optimally for learning. With the development of digital teaching materials, it is hoped that the use of cellphones in schools can have a positive impact. Teaching materials pop-up book digital was developed with attractive audio and visual displays, according to the needs of students who prefer video and audio displays. Students

can easily download material because there is WiFi access at school, and adequate headset facilities are also available. This facility underlies the development of teaching materials from print to digital media.

The teaching and learning process expects students to be able to understand learning material and achieve learning goals. To achieve this success, teachers must be able to create a learning process that motivates and activates students. The teacher's role is not only to deliver material, but also to create or develop interesting learning media, one of which is by utilizing technology. According to Suteja *et al.* (2008), information technology allows the creation of new teaching techniques through interactive media such as CDs or videos. Therefore, teachers do not always have to rely on the blackboard. They must master the subject matter and make it interesting for students. Good, creative and innovative teaching materials can create an interesting learning experience. This is in line with the competency demands that must be possessed by 21st century teachers, who are able to combine information and communication technology in learning. According to Rusman (2018), an important problem in 21st century teacher learning is the integration of computer technology in learning activities.

Interviews with class VIII science teachers show that material related to the physiology of the human body requires simpler and more interesting explanations because of its complex and abstract nature. Delivery of material through audio-visual teaching materials such as pop-up book It is hoped that digital can raise students' curiosity and interest, make learning less boring, and make understanding easier. According to Sanjaya (2014), the advantages of audio-visual media in learning include: (1) providing learning experiences that cannot be learned directly, (2) making learning more varied and increasing enthusiasm for learning, and (3) functioning as a learning resource that allows participants Students learn independently without depending on the presence of the teacher.

Planning

The design stage aims to design teaching materials with a format that includes a cover, description of teaching materials, basic competencies, indicators, learning objectives, motivation for students, material descriptions, activities, exercises, bibliography, glossary and conclusion. The cover provides a general overview of the teaching material, while the description reveals the development that has been carried out. Basic competencies explain what will be achieved after studying teaching materials, and learning objectives are designed so that students have clear targets. According to Novana (2014), learning objectives include indicators that students must master after studying the material, and must be specific, measurable, achievable, relevant, timely, evaluated and reviewed (SMARTER). Good objectives help teachers prepare clear lesson content and help students understand how to learn. Motivational pages in teaching materials aim to arouse students' interest in the material, while material descriptions present the knowledge that must be learned and mastered. Exercises are used to measure students' abilities after studying teaching materials, and glossaries help students remember important definitions. The bibliography lists references used in preparing teaching materials.

Teaching materials pop-up book digital for the human respiratory system is divided into three parts: respiratory organs, respiratory mechanisms, and disorders and efforts to maintain respiratory health. Material and images are collected from various sources and arranged in simple language so that it is easy to understand. The examples presented are relevant to everyday life and the pictures provide reinforcement of the material.

The six principles of text and image design that must be considered include a positive impression according to the characteristics of students, readability of text, clarity of images, attractive layout, attractiveness of images, and arousing interest in learning. Apart from text and images, sound recordings containing teaching materials are also prepared, because audio media can make learning more interesting and less monotonous (Ambarsari, 2017; Wijayanti, 2016).

Instruments for assessing the feasibility, practicality and effectiveness of teaching materials pop-up book digital is also prepared. Feasibility was assessed using content and media validation instruments, practicality using teacher and student response instruments, and effectiveness using student learning motivation questionnaires. These instruments include grids, assessment rubrics, and validation sheets to obtain feedback that helps improve the quality of teaching materials.

Development

Fajarini and Depict (2021) explain that in developing teaching materials there are two main objectives that need to be achieved: (1) Producing, purchasing, or revising teaching materials that will be used to achieve predetermined learning objectives, and (2) Selecting the best teaching materials to achieve learning goals. Teaching materials about the human respiratory system, which were previously in the form of print media, have been modified to be more in line with current developments and the needs of students. The designs that have been created at the design stage are then realized into real products in the form of teaching materials pop-up book digital using the application Microsoft Office PowerPoint 365 version and Capcut application.

This development procedure follows the content description script that was prepared at the design stage. One important aspect in making teaching materials pop-up book digital is color selection. The colors used must be considered carefully because they have meaning and psychological influence. In general, colors consist of two main groups that can influence psychology, namely warm colors that evoke emotions and cool colors that create calm. Warm colors include red, orange, and yellow, while cool colors include blue, purple, and green. Teaching materials pop-up book digital presents material along with pictures and full color pages. Research shows that some people can concentrate better and are motivated when faced with green situations. The color red can attract attention, generate energy, enthusiasm and self-confidence. Yellow can increase metabolism, cheerfulness and optimism. Purple is considered to trigger creativity and focus, while orange creates feelings of joy, warmth, energy, creativity and enthusiasm. Meanwhile, the color blue is associated with a feeling of calm and relaxation.

Educational products pop-up book digital data that has been completed is then validated by experts. According to Arikunto (2013), validity is a measure that shows the level of validity or authenticity of an instrument or product. Validation aims to measure the suitability of teaching materials before they are field tested using an instrument in the form of a validation sheet. Instruments that have been validated and revised include teaching materials pop-up book digital parts I, II, and III, learning motivation questionnaire, questions *post test* and *retest*, observation sheets of student learning activities, as well as teacher and student response questionnaires.

Teaching materials pop-up book digital part I discusses the organs that make up the human respiratory system and their functions. Part II discusses the mechanisms of human breathing. Meanwhile, part III discusses disorders that can attack the respiratory system as well as efforts to prevent and treat them.

Validity of teaching materials

1) Ratings by content members

The results of the content expert's evaluation of the teaching materials pop-up book digital shows an assessment percentage of 94.4%, which means the teaching material is very suitable for use. Aspects assessed include the accuracy of the title and the content of the material, clarity of description, basic competencies and indicators, learning objectives, suitability between learning objectives and material, description of material, practice questions, pictures/illustrations, student activities, writing a bibliography, and glossary.

Content validation of teaching materials is an important step in development to ensure suitability to learning needs. This validation aims to ensure that the information presented is accurate, up-to-date and in accordance with the facts, and easy to understand by the target students. The validation process helps identify deficiencies or errors, so that teaching materials can be corrected and perfected, which will ultimately help students achieve learning goals.

2) Assessment by media members

Media experts' assessment of digital pop-up book teaching materials shows a percentage of 87.5%, which is also in the very feasible category. Aspects assessed include the physical appearance of the cover and the teaching materials. The cover of teaching materials has dominant title letters, contrasting colors, and balanced images and text. Each page of teaching materials contains images supporting the material in a fairly large size and with contrasting background colors. The text and background sounds are arranged to complement each other.

Media validation aims to ensure that the media used is appropriate to learning objectives, inspires student engagement, and facilitates deep understanding. This validation also ensures that teaching materials can accommodate various student learning styles, utilize technology effectively, and are inclusive and accessible to all students.

3) Practicality of teaching materials

The practicality of teaching materials is very important in modern education, where technology continues to develop. Practical teaching materials allow easy access, simple use, and better understanding of the material. Accessibility is the main aspect, allowing students to access teaching materials via cellphone, supporting distance learning, and learning anywhere. Practicality also allows for variety in learning methods, supports a variety of learning styles, and creates an inclusive and flexible learning environment.

4) Effectiveness of teaching materials

Teaching materials pop-up book digital contributes to students' learning motivation. Based on calculations effect size, there was a small influence on 4 students and a moderate influence on 11 students. Factors that influence learning motivation include student aspirations, physical and spiritual conditions, environment, and teacher efforts in the process learning (Sudaryono, 2012).

Use of teaching materials pop-up book digital attracts students' attention, increases curiosity, and makes them focus more on the material. Before using this teaching material, many students were not focused and often talked to their classmates or daydreamed. Increased learning motivation after using teaching materials pop-up book digital is in line with Hamalik's theory (Arsyad, 2011) which states that learning media can arouse desire, interest,

motivation and stimulation of learning activities, as well as bringing a positive psychological influence on students.

Implementation

Increasing student learning activities

Dimyati and Mudjiono (2010) stated that learning activities are students' activeness in the learning process to construct their own knowledge. Students actively develop an understanding of the problems and all the things they face in learning. Every individual must learn actively to develop their potential. Without learning activities, the learning process becomes uninteresting. Students are required to process and process their learning gains continuously. To make the learning process interesting, students must interact well in the learning process.

Student activity in the learning process is very important to achieve learning goals. Therefore, the use of teaching materials that can stimulate student activity is very necessary to maximize learning, especially in science subjects. The active learning process can be seen from the interactions created both between teachers and students and between students with each other. This will create a more active and conducive classroom atmosphere, where each student can use their abilities to the maximum. The activities that emerge from students will influence the formation of knowledge and skills that lead to improved learning outcomes.

The focus of observing student learning activities in this research is visual, verbal, listening, metric, mental and emotional activities. An overview of students' learning activities using printed and teaching materials pop-up book digital can be seen in figure 3. This figure shows that students' visual activity has increased significantly after using digital pop-up book teaching materials. This is because at the first meeting, students' concentration did not last long when they were asked to pay attention to the material in printed teaching materials. However, when using teaching materials pop-up book digital, their attention is quite large because the presentation is attractive and can be accessed via their respective cellphones. In other words, teaching materials pop-up book very effective in increasing students' visual activity. This increase in student activity is in line with the opinion of Yamin (2007) who states that learning activities are students' efforts in the learning process to build knowledge within themselves. In the learning process, changes and improvements in the quality of their abilities occur, such as daring to ask questions, expressing opinions, listening well to the teacher's explanations, and doing assignments on time.

The increase in visual activity is of course in line with the increase in oral activity. When using printed teaching materials, students quickly feel bored so they are less stimulated to explore deeper knowledge through asking, answering and discussing activities. Meanwhile, when using teaching materials pop-up book digital, many interesting things are found in teaching materials that stimulate students to ask, answer and discuss.

The percentage of listening activities when learning using printed teaching materials is still low due to the decreased concentration of some students when the teacher explains and during discussions. Listening activities increased after using teaching materials pop-up book digital because the material is delivered through text, images and audio. Students listen via headset so they can focus more on the material. This increase in listening activities is also supported by teacher activities which are able to make the classroom atmosphere more interesting when learning.

With an attractive classroom atmosphere and the use of more modern teaching materials that keep up with the times, students become more enthusiastic in the learning process and increase their metric activities. Based on observations, when using printed teaching materials, students do not make maximum use of the time given by the teacher. There are still students who submit questions past the time limit. However, when using teaching materials pop-up book digitally, students are able to solve problems independently and help other group members who experience problems. The remaining time is used to discuss the answers of each group member to ensure that the questions have been answered well.

Metric activities that run well ultimately influence mental activity. When using printed teaching materials, students are not confident enough to present their answers or respond to their friends' opinions. However, when using teaching materials pop-up book digitally, students are better prepared to present the results of group discussions with teacher guidance and direction. They also dare to express opinions and answer questions from other groups. This activeness occurs because students actively build understanding of the problems they face in the learning process.

Students' interest in the material in teaching materials pop-up book digital triggers learning interactions between students in discussing material. Teaching materials pop-up book can provide a more interesting visualization of the story, making learning more enjoyable than ordinary books. This is in line with the opinion of Zaini (2005) who states that when students learn actively, they dominate learning activities, actively using their brains to find the main idea of the material, solve problems, or apply what they have just learned to real life. Active learning invites students to participate in all learning processes, both mentally and physically.

The different material at each meeting also influences students' enthusiasm in mental activities, such as discussions between groups. During mental activities, emotional activities are also involved. When using printed teaching materials, discussions are not active so emotional activity is low. However, when using digital pop-up book teaching materials, active discussions result in increased emotional activity. Students show respect for their friends' answers and opinions.

Increasing student learning activities through teaching materials pop-up book digital has a good impact on improving learning outcomes. The involvement of students in various learning activities creates a learning atmosphere that is not boring and influences their learning outcomes.

In students' learning activities, emotional activities are more prominent than mental activities. This is because learning not only involves cognitive aspects but also emotional aspects which are important in forming students' characters. Learning involves social interaction between teachers and students, which includes feelings, emotions, and interpersonal relationships. Students who feel cared for and appreciated by teachers are more motivated to learn. In addition, emotional activities involve the process of conveying information and understanding through language, which has an emotional aspect.

Students who feel comfortable and safe in the learning environment find it easier to absorb information and understand lessons. In contrast, mental activities involve the ability to think critically, analyze information, and solve problems. Students with good mental abilities find it easier to express opinions or ask questions about the obstacles they face, so that the material is easier to understand and apply in everyday life. Therefore, it is important for teachers to create a learning environment that is balanced between emotional and mental activities. Teachers can create a comfortable and safe learning environment, provide attention and support, and provide opportunities for critical thinking and analyzing information.

Increasing student retention

To measure students' retention power after using teaching materials pop-up book digitally, given multiple choice objective questions. The objective question form was chosen because it is effective for measuring memory or memorization (Kunandar, 2013).

Retention measurement data shows that there is a decrease in value when *retest* compared to value *post test*. This is caused by the forgetting effect that occurs on students, because *retest* carried out 10 days after *post test*. At the level of *post test*, students are informed beforehand so they can prepare themselves by studying using teaching materials pop-up book digital. However, *retest* carried out without prior notification, so it is likely that students have no preparation. According to Rahman (2002), "*forgetting is normal everyday and constant reminder of our limitations*", forgetting is a natural thing because of human limitations in remembering. In the 10 days before *retest*, students have received new material in science subjects and other subjects, which can affect their ability to remember previous material. However, there is still material stored in students' memories, as seen in the retention power analysis in Figure 2 shows that the retention power of students who use teaching materials pop-up book digital is higher than printed teaching materials. Teaching materials pop-up book digital, which combines audio and visual elements, provides a more interesting learning experience and helps improve students' memory of the material presented. Presenting material through clear illustrations contributes well to understanding concepts, because visualization helps remember information better (Erryanti & Poedjiastoeti, 2013).

Evaluation

Formative evaluation refers to the process of continuously collecting data and information to evaluate, monitor, and improve teaching materials pop-up book digital. Formative evaluation provides an opportunity to adapt teaching materials to better suit students' needs. The techniques used in the formative evaluation stage according to Philips (1997) include: (1) reviews from experts, in the form of comments or feedback about the condition of the multimedia being developed, including information about the completeness and accuracy of the content, motivation and learning strategies that ar e being developed. used, screen design, general beauty and ease of use, (2) Observations and interviews with students or users, where this technique can be carried out both structured and unstructured.

Formative evaluation in this research was obtained from validators, teachers and students in small groups in the form of comments, input and suggestions. As a replacement for previously used printed teaching materials, teaching materials pop-up book digital must be valid before being used in learning. Therefore, teaching materials pop-up book digital data was analyzed by 3 validators who assessed content and media aspects.

Science teaching materials on the human respiratory system were developed to meet the needs of students in studying material that is considered difficult to understand and boring. Based on the results of the analysis of the validity assessment of teaching materials by teaching materials experts pop-up book digital received a very good response seen from the results of the validator's assessment

with a very valid category, and is suitable for testing with several improvements according to input and suggestions from the validator.

Comments were also obtained from teachers and students in small groups, including errors in typing, writing lowercase and capital letters, as well as editing errors. These inputs are really needed to create teaching materials pop-up book digital is good, especially in delivering the material. Teaching materials pop-up book digital has been revised according to input from validators, teachers and students, before being used in the implementation stage.

Evaluation of teaching materials is also carried out through summative evaluation, which is more oriented towards the level of effectiveness of teaching materials, ensuring that the teaching materials pop-up book digital is in accordance with quality standards and can be effectively used in the learning process to increase student activity and retention. This is an important part in assessing the success of the teaching materials that have been developed. In this research, a summative evaluation was carried out to see the achievement of learning objectives, increased activity and student retention.

From the results *pre test* and *post test* when using printed teaching materials, no students have yet achieved the minimum completeness criteria, even though there has been an increase in grades during implementation *post test*. This is the case when carrying out a pretest before learning using teaching materials pop-up book digital. Different results are visible through the results *post test* after studying the material through teaching materials pop-up book digital where there were 15 students who achieved the KKM score. This level of completeness has not yet reached the classical completeness criteria. A class is said to have completed its learning (classical completeness) if there are ≥ 85% of students who have completed their learning. However, there has been a significant increase in results *pretest* because students have taken part in learning and gained an understanding of the human respiratory system material through teaching materials pop-up book digital.

Apart from classical completeness, we can see the individual completeness achieved in this learning. Students are said to have completed their learning (individual completeness) if the proportion of correct answers is ≥ 65%. Of the 20 multiple choice questions given, students must answer 13 questions correctly. And after analysis, there were 16 students who achieved individual completeness.

Apart from achieving learning objectives, an evaluation was also carried out on the increase in learning activities of students in the treatment class. One of the reasons why the developed teaching materials have a big influence on increasing student activity is because of their ability to visualize abstract concepts, facilitate better understanding, and provide a more interesting learning experience. Through the delivery of simpler material and pictures contained in teaching materials pop-up book digital students can quickly understand scientific concepts that are difficult to understand through conventional teaching methods.

Teaching materials pop-up book digital also plays a big role in increasing student retention. The use of audio-visual teaching materials can create a more interesting learning experience for students. By utilizing images and sound, students can be more actively involved in the learning process. This can trigger a higher interest in learning and allow students to be more focused and involved in the material presented. Audio visual teaching materials can also help students understand complex concepts. This can help strengthen students' understanding of the lesson material. Research shows that students tend to be better able to remember information conveyed through audio-visual teaching materials compared to conventional learning methods. This is caused by the ability of audio-visual teaching materials to create stronger memory bonds in students' brains.

Conclusions

After going through the stages of developing the ADDIE model to produce a product in the form of model science teaching materials pop-up book digital, it can be concluded that this teaching material is very suitable for use in learning in class VIII B of SMP Negeri 3 Bungku because it meets the criteria of being valid, practical and effective. The application of digital pop up book model science teaching materials can increase student activity in the class. Observation results show that all indicators of students' learning activities have increased after participating in learning using this teaching material. Apart from that, the results of the retention power calculation showed satisfactory results with 17 students included in the high category, 12 people in the medium category, and only 1 person in the low category. Differences in retention power among students are influenced by external and internal factors. External factors include material characteristics, students' academic abilities, retention test implementation time, and the atmosphere of the physical environment, while internal factors include health factors, individual learning modalities, distractions, and emotions.

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Conflict of interest

The authors declares that there is no conflict of interest in this research. All parties involved have given their consent and contributed without any bias or influence that could affect the research results.

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