



## The Effectiveness of Respiratory System Supplement Based on Research for Increasing Motivation and Learning Outcomes in High School

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### Abstract

A survey of 612 students in one of the high schools in the city of Semarang is found 177 shisha smokers. Based on the results of the survey, students haven't known the effects and harmful contents of the shisha which they consumed. The use of supplement based on research could increase student knowledge about the dangers of shisha. Manufacture of products based on research data. Learning resources developed are supplement. The appropriateness of product is carried out by the media validator and material validator. Furthermore, the products were tested on 34 students, namely grade XI students of SMA Negeri 1 Kutowinangun. Data collection techniques used questionnaires and written tests. The data analysis method is quantitative descriptive. Based on the results of product validation which it showed very valid. Scores from material experts is 84% and media experts is 98%. The readability test results in the form of teacher and student responses showed increasing results. The effectiveness of supplement is proved by the scores obtained on motivation scores in before and after learning which increased by 4% with an average percentage in after learning is 77%. Student learning outcomes that have achieved KKM value showed 76,5% and the average N-gain was 0.66 in the medium category. This shows that supplement based on research are effective for increasing motivation and student learning outcomes in high school.

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## INTRODUCTION

A survey of 612 students in one of the high schools in the city of Semarang contained 177 student which they are shisha smokers (Pangestu, 2017). Based on the results of the survey, students haven't known the effects and harmful contents of the shisha which they consumed. The survey results also showed that most students who consumed shisha from several cafes located close to their school. One of the cafes that they visited was near SMA X and also close to one of the largest universities in the city of Semarang. These conditions have a great influence on students' behavior and lifestyle because they can be easily influenced from their environment.

Presidential decree 32 (2013) competence is a set of attitudes, knowledge, and skills that must be possessed, internalized, and mastered by students after learning. Basic competency of respiratory system material in high school that is 3.8 to analyze the relationship between the structure of organ in the respiratory system and their function and 4.8 to present the effects of air pollution in structure and function human respiratory organs based on literature studies. Based on observations at High School 1 Kutowinangun especially on the respiration system material, there are still low students who have not reached Kriteria Ketuntasan Minimal (KKM). The factor that caused student got low score that was not optimal use of relevant learning resources. The textbooks that's used still have some shortcomings including: the books are not equipped with pictures, limit for discussions, still textual, illustrations are still universal, so the supplement is difficult to be understood by students. Cases or various life problems are less. Therefore, supplement is developed for completing book which existed yet, so it helps students to understand concepts and give the more deep information in respiration system chapter.

The supplement development aims to increase student motivation and learning outcomes. Based on observations at school, student learning outcomes are still low. As many as 38% of students scored below the KKM on the respiratory system material. In addition, the results of observations on students' motivation and interest in supplements based on research showed a positive response. Students are attracted by new learning resources. Therefore, supplements based on research were developed as an attractive source of student learning.

The development of supplement based on research to support the respiration system material is for completing biology textbooks and containing material and research results on the effect of shisha tobacco smoke exposure on the histopathological structure of the rat trachea. Students are more aware about various abnormalities and concepts of tissue structure and function in the respiratory organ. In addition, students or the public are more aware for keeping a healthy and lifestyle to avoid smoking and shisha. The use of supplement based on research can make learning more contextual and enjoyable. According with 2013 curriculum which is based on character and competence for changing the pattern of education from orientation to results and educational material as a process, through a contextual approach. So that learning involves students as much as possible so they can explore their competencies by scientific truths.

The preparation of supplement is carried out by including the process and results of research. Development of supplement based on research data from shisha tobacco experiment. Furthermore, the data is included in content on supplement that are adjusted based on basic competencies in the respiration system material. Some of the advantages of supplement compared to other learning sources are: 1) as the development of material on existing learning resources so that the purpose of learning is more effective, 2) the material in supplement is the result of research of tobacco smoke exposure shisha that is completed with color picture, 3) preparation of the supplement added shisha research and other research that's related to the material, 4) displaying tracheal histology structure so as to increase student knowledge about the function and structure of tissues in organs respiration. This is in accordance with the KD in the respiration system material, that students analyze the structure and function of the human respirator, 5) there are cases in the form of information or news as learning and motivation, 6) there are cases that need to be solved there are

several questions related to related cases. In addition, there are messages related to examples of cases or news in the community that have been provided. The case is as student learning so students can take wisdom and be aware of the dangers of shisha based on the case or the news. Based on some of these advantages, biology teacher SMA N 1 Kutowinangun felt strongly if there was a development of learning resources based on the results of research on the effects of shisha cigarette exposure on rat tracheal organs. Therefore the development of learning resources in the form of supplement based on research data on the effects of shisha cigarette exposure on rat tracheal organs on Respiratory System Material in high school is important to do in order to increase deeper student knowledge.

## METHODE

Research "Respiratory system supplement based on research to improve student motivation and learning outcomes" is a RnD study developed based on Sugiono's 10 research steps (2017). Broadly speaking, this research is divided into 2 stages, namely the supplement development stage and the implementation stage. The supplement development stage is carried out in the Biology Department of FMIPA. The implementation stage, namely small-scale trials and large-scale trials conducted at SMA Negeri 1 Kutowinangun. The research subjects in this study were the small scale test on 15 students of class XII MIPA 3 SMA Negeri 1 Kutowinangun and one of the class XI teachers of SMA Negeri 1 Kutowinangun. Effectiveness test on 34 students of class XI. MIPA 1 SMA Negeri 1 Kutowinangun. The two stages in this research were carried out in August 2019 to June 2020. Analysis of the needs in the development of respiratory system supplement based on research was known by conducting interviews with one of the biology teachers and distributing questionnaires to students. Based on interviews and needs analysis questionnaires, it is necessary to develop a respiratory system supplement based on research to increase students' knowledge of the respiratory system material. The preparation of products is based on a needs analysis and learning competencies on the respiratory system material.

There are two tests on respiratory system supplement based on research, that are validity test and the effectiveness test. The validity test includes the material and media validity test as well as the legibility test, namely in the form of teacher and student response tests. After the supplement is said to be valid, an effectiveness test is carried out which includes a test to increase motivation and learning outcomes. Supplement are said to be valid if 1) the results of the supplement validity test by material and media experts show a percentage of  $\geq 70\%$  is valid to very valid, 2) the results of teacher and student responses at least show a percentage of  $\geq 70\%$  are in good criteria (Posia et al., 2018). Supplement are said to be effective if 1) student learning outcomes show  $\geq 75\%$  of students reach the KKM limit (KKM value = 70) and the percentage of students who get  $g \geq 0.3$  that is  $> 76\%$  (Arikuno & Suharsimi, 2013). 2) Supplement are said to be effective if  $\geq 75\%$  of students show good criteria and experience an increase in the percentage of scores before and after learning using respiratory system supplement based on research.

## RESULTS AND DISCUSSION

Shisha tobacco can cause changes in the respiratory epithelium to become enlarged and damage to the cilia. Repeated exposure to tobacco smoke is thought to increase the mitotic index in the epithelium of the respiratory tract of experimental animals which will then cause goblet cell hyperplasia. In addition, there is a difference in cells that experience necrosis, there is swelling of the cells resulting in narrowing of the tracheal channel (lumen) as well as ciliary damage and inflammation indicating cells are injured and are an early symptom of necrosis. (Jog & Caricchio, 2014). The chemicals in shisha tobacco smoke consist of irritating active substances, not germs, so the epithelial cells are more easily damaged. Likewise, with the

cilia. In addition, the cells under the epithelium will also be affected. As a result, thick mucus or liquid may appear. Furthermore, the airways are slightly contracted, because the nerves are disturbed (Junqueira, 1980).

Preparation of teaching material supplement based on shisha research as a support material for the respiratory system can make learning more memorable. The use of supplement is expected to be able to clear insight about the dangers of shisha to health and clarify the concepts in KD 3.8 and 4.8 namely the analysis of the structure and function of tissues in the respiratory organs and various disorders in the respiratory organs. Broadly speaking, this research is divided into 2 stages, namely the stages of product development and implementation. The development phase begins with the preparation of supplement based on the syllabus and preparing a learning plan that refers to the basic competencies of the 2013 curriculum, namely KD 3.8 and KD 4.8. Stages of implementation begin with testing the feasibility and readability of supplement by validating supplement to material and media experts and conducting test responses to teachers and students. After that the supplement effectiveness test was conducted to determine the increase in motivation and student learning outcomes using supplement based on respiration system material in high school.

**Validity of Supplement Based on Research**

Validation of supplement is carried out by 2 experts namely material experts and media experts. Supplement is said to be valid if the results of the assessment of the material experts and the media are in the proper to very valid category. Determination of the validity of supplement based on 4 component aspects based on BNSP that are: aspects of content eligibility, presentation, graphics, and language. The content and presentation aspects were validated by the material experts. While the graphic and linguistic aspects are validated by media experts.

Based on the results of media validation obtained an average percentage of 97.82% with a very valid criterion. The results of the validity by media experts can be seen based on the table below:

**Table 1** Analysis of validitas result by media expert

No	Aspect	Score
<b>GRAPHICS</b>		
A.	Size of Supplemen	8
B.	Cover Design	31
C.	Content	55
<b>Score of the graphic aspect</b>		<b>94</b>
<b>LANGUAGE</b>		
A.	Straightforward	12
B.	Communicative	4
C.	Dialogic and Interactive	7
D.	Based on the Level of Student Development	8
E.	Comformity with Language Rules	8
F.	Use of Terms/Symbols	4
<b>Score of the language aspect</b>		<b>43</b>
<b>Total score</b>		<b>137</b>
<b>Maximum score</b>		<b>140</b>
<b>Ppercentage score (%)</b>		<b>98</b>
<b>Criteria</b>		<b>Very valid</b>

Based on the results of the validity by the media experts presented in Table 1, supplement based on research can be used in small-scale tests. The results of the assessment of aspects of language and graphic can be seen in the following discussion:

There are indicators of linguistic aspects including: straightforward, communicative, dialogic and interactive, appropriateness of supplement language with the development of students, conformity with language rules, and the use of clear symbols and symbols in accordance with the provisions of learning resources according to BSNP. Almost all the problem points for each indicator on linguistic aspects get a maximum score (4). Only one indicator of all indicators contained in the language aspect that gets a score is not optimal. These indicators are dialogic and interactive. There are 1 question out of a total of 2 questions on this indicator that get a value of 3. This means that overall, the six indicators of the language aspect get maximum value and are very valid.

There are indicators of the graphic aspects include: the size of the supplement, the design of the supplement cover, and the design of the supplement content. Based on the results of the assessment in Table 2, almost all the question points on each indicator on the graphic aspect also get a maximum score (4). The results of the score on the aspect of graphics get a value of 94 from a maximum score of 96. This means that there are 2 questions that do not get the maximum score on each indicator. The problem is that it is on the cover design indicator and the content design that only 1 question from each of these indicators gets an imperfect score (3). This means that only 2 questions out of a total of 24 questions in the graphic aspect got a score of 3 while the remaining 22 questions got a maximum score (4). This is because the cover design still looks pale and the contents of the page are still cramped so that it needs to be repaired so supplement are more comfortable for students.

While the aspect of content feasibility and presentation is validated by the material expert. Based on the results of the validation of the material obtained an average percentage of 84 % with a very decent category. The results of the validity by the material experts for supplement respiration system based on research can be seen based on the table below:

**Table 2** Analysis of validitas result by material expert

No	Aspect	Score
<b>CONTENT ELIGIBILITY</b>		
A.	Material suitability with basic competencies	8
B.	Material accuracy	31
C.	Material updates	55
<b>Score for the content eligibility aspect</b>		<b>53</b>
<b>PRESENTATION ELIGIBILITY</b>		
A.	Presentation technique	12
B.	Supporting presentation	4
C.	Presentation of learning	7
D.	Coherence and thought flow	8
<b>Score for presentation eligibility aspects</b>		<b>31</b>
<b>The total score</b>		<b>84</b>
<b>The total score maximum</b>		100
<b>Score presentation (%)</b>		84
<b>Criteria</b>		Very valid

Based on the results of the validity by the material experts presented in Table 2, supplement of respiration system material can be used in small-scale tests. Some suggestions and input from material experts, namely to improve writing procedures in supplement. The results of the assessment of aspects of language and graphic can be seen in the following discussion:

In the aspect of content feasibility, there are indicator points, including: the suitability of the material with KD, the accuracy of the material, the up-to-date of the material, and encouraging curiosity. All questions on the four indicator points on the content feasibility aspect got the same result, namely 50% got a score of 3 and 50% got a score of 4. This means that based on the results of the assessment by material

experts, the content feasibility aspect is on the criteria of good to very good. As a whole, the aspect of content feasibility is not revised based on the results of material expert validation. The content feasibility aspect of respiratory system supplement based on research based on the results of the material expert's assessment has been said to be valid.

The aspect of the feasibility of presenting there are indicator points, among others: presentation techniques, presentation support, presentation of learning, coherence and sequence of thought lines. Almost all question points on each indicator in the aspect of content feasibility get a score of 3 or good information. Only one indicator of all indicators contained in the aspect of presentation feasibility gets the maximum score. This indicator is a supporter of presentation. There is 1 question out of a total of 6 questions on this indicator that gets a score of 4. The questions in the statement state that case examples in learning activities are useful in everyday life. This is of course relevant when it comes to the content of a respiratory system supplement based on research that presents various cases based on the results of research on shisha in everyday life. Some suggestions and revisions to supplement are mostly in the aspect of feasibility of serving. This is because some systematics in writing still need to be improved. For example, such as inconsistent capital letters in table titles, supplementary bibliography does not pay attention to EYD, there are some texts that are still written incorrectly.

#### Teacher and Student Responses to the Respiratory System Teaching Material Supplement

Response tests on teachers and students based on this study were conducted using a response questionnaire that was distributed using *Google forms*. Questionnaire was given to one of the biology teachers. Questionnaire filling time is after the teacher and students read and understand about supplement. The answer from the questionnaire will later be converted into a Likert scale to calculate the scoring results.

**Table 3** Analysis of teacher responses result

Indicator	Score (%)	Criteria
Presentation technique	79	Good
Language suitability	96	Very good
Material suitability	75	Good
Material accuracy	82	Very good
Practicality	75	Good
<b>Average</b>	81	<b>Very good</b>

Based on the results of the teacher's response to the readability test for respiratory system supplement based on research, an average percentage is 81% that it was obtained with very good criteria. Where the percentage of teacher responses to respiratory system supplement based on research in presentation technique, material suitability, and practicality aspects are good. Language suitability and material accuracy aspects are very good.

Furthermore, the student response questionnaire was tried out on 15 students. The questionnaire contains 20 questions regarding 4 aspects, namely aspects of material, language, interests, and motivation. The results of student responses to respiratory system supplement based on research can be seen in Table 4.

**Table 4** Analysis of the results of students' responses to respiratory system supplement based on research

No	Code	Score	Persentations (%)	Criteria
1.	UK-01	62	78	Good
2.	UK-02	64	80	Good
3.	UK-03	61	76	Good
4.	UK-04	60	75	Good
5.	UK-05	66	83	Very good

6.	UK-06	62	78	<b>Good</b>
7.	UK-07	67	84	<b>Very good</b>
8.	UK-08	70	88	<b>Very good</b>
9.	UK-09	60	75	<b>Good</b>
10.	UK-10	64	80	<b>Good</b>
11.	UK-11.	61	76	<b>Good</b>
12.	UK-12.	65	81	<b>Very good</b>
13.	UK-13.	67	84	<b>Very good</b>
14.	UK-14.	64	80	<b>Good</b>
15.	UK-15.	60	75	<b>Good</b>

Based on trials of 15 students, 33% of students stated very good and 67% of students stated good response to respiratory system supplement based on research as additional learning resources on the respiratory system material. The general response is that the learning media is attractive, the material is easy to understand, the design is attractive, the pictures and illustrations are attractive. This is because the supplement is equipped with color pictures of research results, the material is contextual, and supplement is equipped with examples of cases in everyday life. In addition, the language used is easy to understand because the supplementary language is in accordance with student development.

**The Effectiveness of Supplement to Increase Student Learning Motivation**

Motivation questionnaire was given 2 times, that is before the pre-test and after the post-test. Students are asked to fill in a motivational questionnaire consisting of 15 questions arranged based on 4 aspects, namely: Attention, Relevance, Confidence, and Satisfaction or often abbreviated as ARCS. These aspects are aspects contained in the implementation steps of the Attention, Relevance, Confidence, Satisfaction (ARCS) model developed by Keller (1987). As for Asiani *et al.*, (2017) develop indicators of motivation questionnaires by adapting from aspects contained in the ARCS model. Indicators of the problem can be seen in Table 5.

**Table 5** Indicators of learning motivation

<b>Aspect</b>	<b>Indicator</b>
<b>Attention</b>	Able to stimulate curiosity and interest
<b>Relevance</b>	Able to make students' mindset so that they can relate the benefits of supplements to everyday life
<b>Confident</b>	Able to generate the desire to feel competent
<b>Satisfaction</b>	Able to motivate students to get awards or who satisfy students both in the sense and achievement itself through learning resources

Adapted from Asiani *et al.*, (2017) and modified based on field needs.

Motivation questionnaire was given to 34 students in the form of Google form. The time for conducting each questionnaire was that before learning to use supplement students were given a motivation questionnaire and after learning to use supplement students were asked to fill in the motivation questionnaires. The purpose of the questionnaire was given before and after learning by supplement that is to find out the increase in student motivation after using supplement. Analysis of the results of student motivation before learning is presented in the form of Table 6.

**Table 6** Analysis of the results of student motivation before using supplement

<b>Percentage of motivation score (%)</b>	<b>Student percentage (%)</b>	<b>Criteria</b>
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$\geq 72$	77	Good
$< 72$	23	Good enough

**Table 7** Results of the average percentage of motivational scores after using supplement

Percentage of motivation score (%)	Student percentage (%)	Criteria
$\geq 72$	91	Good
$< 72$	9	Good enough

Furthermore, data on the results of the percentage of students' motivation scores before and after learning are analyzed to see the percentage increase in student motivation. The percentage increase of students' motivation scores before and after learning. Based on the table Before using the supplement, students who answered with a score of  $\geq 0, 72$  were 77% and students who answered with a score of  $<72$  were 23%. After using the supplement, students who answered with a score of  $\geq 0, 72$  were 91% and students who answered with a score of  $<72$  were 9%. Based on these data, there was an increase in students who responded well before using supplements, an increase of 14% after students using supplements. Students who achieved the good category (score  $\geq 0.72$ ) after using supplements were quite high, namely 91% of students stated a good response. This is in accordance with the opinion of Asiani et al. (2017) which states that if students who reach the good category are 75%, it shows that supplement are effective in increasing student learning motivation. Students expressed a good response because most students felt interested in learning new things and supplements were easy to understand because the language used was in accordance with student development. Students expressed a good enough on average, they find it difficult to understand the material in the supplement and they are more interested in learning resources in the form of videos or films.

**Table 8** Analysis of the increase in percentage of student motivation scores

Questionnaire testing time	The percentage of students who score with good criteria (%)
Before using supplement	77
After using supplement	91
<b>Percentage increase (%)</b>	<b>14</b>

Based on the results of research on the effect of respiratory system supplement based on research on learning motivation, there was an increase in the percentage of students who obtained good criteria ( $\geq 72\%$ ) before and after using respiratory system supplement based on research, that is 14%. In the test results after using a respiratory system supplement based on research, it was found that students who obtained a percentage is 72% or were in good criteria were 91% of the 34 students tested. Asiani et al. (2017) which states that if students who reach the good category are 75%, it shows that supplement are effective in increasing student learning motivation. The results of increasing the percentage of motivation and the results of the percentage of motivation after using the supplement showed that respiratory system supplement based on research were effective for increasing learning motivation.

### The Effectiveness of Supplement Based on Research to Improve Student Learning Outcomes

Learning outcomes are obtained through pre-test and post-test using multiple choice question instruments. Pre-test and post-test data are used to determine the classical completeness and N-gain presented in Table 9.

**Table 9** The recapitulation results of learning outcomes

Information	Unit
Student qualified	26
Student not qualified	8



<b>Score qualification(%)</b>	<b>76,5</b>
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Based on the results of the post-test which has been done using supplement is said to be effective in increasing student motivation and learning outcomes because the result of test showed students have reached KKM more than 75%. Based on date 76.5% or 26 with the total number of students used as a sample of 34 have reached KKM. The sample used meets the criteria for the number of samples to test the effectiveness of a product. According to Alwi (2019) that in testing the effectiveness of a product at least applied to 30 respondents. This is also in line with the opinion of Agung (2006) which states that the sample size in a study is greater than 30 and smaller than 500. The pre-test and post-test scores are the values needed to find out the increase in student learning outcomes through the value of N- Gain. The N-Gain value can be seen in the table below.

**Table 10** Recapitulation of N-gain test results

<b>Total students</b>	<b>N-Gain</b>	<b>Presentations</b>	<b>Criteria</b>
17	>0,70	50%	High
12	0,31-0,7	35,3%	Medium
5	≤0,3	14,7%	Low
<b>Average</b>	<b>0,66</b>		<b>Medium</b>

Based on table 10 students who get  $g \geq 0.3$  are 85.3% in the range  $\geq 76\%$ . According to Arikunto & Suharsimi (2013), the N-gain value of 85.3% is included in the effective category because it is  $> 76\%$ . Based on the post-test and N-gain scores, respiratory system supplement based on research are effective in learning to improve student learning outcomes in the respiratory system material in high school.

Low interest and motivation cause student learning outcomes in this study to be low. Students who get good post test scores have high learning motivation. According to Sukma (2017), students who are motivated to learn are always confident that they can complete every job they do. The results of each achievement will be maximized if students have high motivation so that high motivation will cause high learning outcomes. Tella (2007) states that students who have high motivation have a good level of learning development and learning outcomes. This statement is supported in Nelson's research (2007) which states that there is a positive relationship between motivation and learning outcomes.

Learning outcomes are an evaluation action that can reveal aspects of the thought process (cognitive domain) and can reveal other psychological aspects, namely aspects of values or attitudes (affective domain) and aspects of skills (psychomotor domain) that are inherent in each individual student (Suprijono, 2012). In this study, the measured learning outcomes are aspects of the students' cognitive domain. Instruments in the assessment of learning outcomes using multiple choice questions. Analysis of the improvement of learning outcomes and product effectiveness can be seen using 2 indicators, namely the N-gain value and KKM. This is because KKM is the target of the education unit as a reference for achieving the competence of each subject. Students are said to have mastered competence in the subject if they have received a score that is not less than the KKM. Because of that, KKM is a reference for students in preparing themselves to take subject assessments. While the N-gain value is an indicator used to analyze student cognitive learning outcomes. Looking for the N-gain value, students are given a pre-test and post-test in order to know the difference between the post-test and pre-test scores. Both are the values needed to determine the increase in student learning outcomes through the N-gain value.

The success of supplement in increasing motivation is closely related to improving learning outcomes. Based on the post-test results, there were 8 students with post-test scores below 70. The low student learning outcomes were influenced by several factors. One of the main factors that influence student learning outcomes is student motivation. According to Siswanto (2016) states that learning outcomes are also influenced by student learning motivation. Students who get high post-test scores because of high student motivation in learning. Students who have high motivation have a significant relationship with

learning resources. Learning sources have a very positive influence on motivation so that learning outcomes increase (Ibrahim, 2015).

The use of research and science-based books in biology learning can make it easier for students to learn the concepts of learning materials (Nur, 2012). This statement is supported by research which states that the use of learning resources in the form of research can make it easier for students to achieve learning competencies (Sumantri, 2012). The material contained in respiratory system supplement based on research must of course be relevant to the basic competencies of learning. All information contained in learning resources must be able to be accounted for (Farida, Herkualana, Salim, 2018). The respiratory system supplement based on research in this study can be justified because the material and the media have been tested for their feasibility and effectiveness in increasing motivation and student learning outcomes on the respiratory system material in high school.

## **CONCLUSION**

Based on the results of research and discussion, it can be concluded that supplements are as follows.

1. Supplements based on research on the respiratory system material are declared worthy of use as a learning resource. This can be proven based on the validity results of the supplement based on material and media experts who claim validity, and the results of the student response test scores with good criteria and teacher responses with very good criteria.
2. Supplements are found to be effective in increasing student motivation. This is indicated by 91% of 34 students obtaining a good motivation score and an increase in the percentage of motivation by 14% before and after using supplements.
3. Supplements are declared effective in improving student learning outcomes on the respiratory system material. This is proven by students who get  $g \geq 0.3$  as much as 85.3% and students who pass the KKM score as much as 76.5%.

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