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### PBL-Based Teaching Materials E-Supplements on Excretion System Materials to Improve Critical Thinking Ability of High School Students

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#### Abstract

This study aims to analyze the validity, readability, and effectiveness of the developed e-supplement teaching materials. The research method used in this research is Research and Development (R&D) according to Sugiyono which has been modified. The indicators measured in the study were the validity, readability, and effectiveness of PBL-based e-supplement teaching materials. The validity of the e-supplement of teaching materials is determined from the validation of material experts, media experts, and biology teachers. Meanwhile, the readability of e-supplements for teaching materials was determined from the responses of nine students in class XI-MIPA 2 and a biology teacher. The results of the effectiveness were determined based on the classical completeness test and the N-Gain test from the results of the pretest-posttest students of class XI-MIPA 1 and XI-MIPA 2. The results showed that the percentage of the validity of e-supplements teaching materials was 88% with very valid criteria and the percentage of readability of e-supplements teaching materials was 84.88% with very good criteria. While the effectiveness test got 78% classical completeness, the N-Gain result was 0.5 (medium), and critical thinking ability was 71.76 (critical). The conclusion obtained from this research is that the e-supplement of PBL-based teaching materials on e

xcretory system material is valid, reads very well, and is effective for improving critical thinking skills of high school students.

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## INTRODUCTION

Biology learning in high school is expected to be able to improve students' abilities in facing challenges and competition in the 21st century era. The abilities referred to are critical thinking, creative, communication skills, and skills in collaboration. Critical thinking skills are needed to be able to solve problems that exist in the environment. This is in accordance with the opinion of Shanti et al. (2017) , critical thinking is an ability that consists of important elements such as interpreting, analyzing, evaluating, and making a decision to solve problems.

To improve critical thinking skills in facing challenges in the 21st century, the Indonesian education system applies the 2013 curriculum. The 2013 curriculum implementation emphasizes student-centered learning so that students are able to develop analytical and critical thinking skills. Despite implementing the 2013 curriculum, students' critical thinking skills in Indonesia are still relatively low. This can be seen from the results of the TIMSS research (2011) which states that Indonesia gets an average score of 386 while the international average score is 500 so that Indonesia is ranked 38 out of 42 participating countries.

Based on the results of interviews with biology teachers in class XI MIPA at SMA Negeri 1 Jakenan that the critical thinking skills of students at SMA Negeri 1 Jakenan are still low, especially in the matter of the excretory system. This is because most students are less active during the ongoing learning activities. Less active students make students' critical thinking skills low. Therefore, we need a learning model that can make students active in finding concepts independently so that students can understand the concepts of the excretory system material and improve critical thinking skills. One of the learning models that can be applied to improve critical thinking skills is the Problem Based Learning (PBL) learning model.

Problem Based Learning is a student-centered learning model that makes students more active, innovative, creative and improves problem-solving skills, concept mastery, and critical thinking skills (Sari *et al.*, 2017) . According to Gultom & Adam (2018) , PBL confronts students with a problem as the first step in learning and educators are responsible for directing students to look for problems and find solutions. Through the problem solving process, students develop their own scientific concepts, analyze problems and solve problems so that it will assist students in improving their critical thinking skills.

The PBL model has several advantages, namely it can improve students' conceptual understanding (M. Sari & Putri, 2012) , improve critical thinking skills (Gultom & Adam, 2018) , improve problem solving skills (Hariyanto, 2015) , and can improve student learning outcomes ( Hariyanto, 2015). Wulandari & Surjono, 2013) . Although PBL has many advantages, the application of the PBL model in Indonesia has not been optimal. Some teachers in several schools still like conventional learning (Kurniati & Surya, 2017) The cause of this condition is the ineffective learning time, some teachers do not understand the PBL syntax or stages and it is difficult to apply the PBL syntax into the lesson plans. Therefore, learning resources that are based or based on PBL syntax and principles are needed so that they can encourage students to think critically in solving problems.

The learning resources that are most often used in learning are textbooks (Komalasari, 2013: 116). The excretory system in the textbook contains the structure and function of the organs that make up the excretory system, the process of urine formation, and abnormalities of the organs that make up the excretory system. After analyzing the material contained in the student handbook, the patterns of human life are not yet in the student handbook. While KD 4.9 requires students to be able to present the results of the analysis of the influence of lifestyle on abnormalities in the structure and function of organs that cause disturbances in the excretory system. Lifestyle knowledge is needed by students to increase students' knowledge or insight in analyzing lifestyles that affect abnormalities or disorders in the structure and function of organs that cause disorders in the excretory system. This can make the basic competencies 3.9 and 4.9 achieved. Therefore, a supplement book is needed to complete the student handbook.

Supplementary books are prepared as supporting teaching materials for teachers to support learning activities in the classroom (Prastowo, 2014). The supplement book that students need in studying excretory system material does not only present materials but must present problems in nature. It can help students

find facts and concepts independently and gain learning experiences. Therefore, it is hoped that students' understanding of concepts can be improved by utilizing supplementary books.

The use of supplements as a complement to teaching materials or enrichment books is also recommended by the government. This is regulated in the Regulation of the Minister of National Education of the Republic of Indonesia Number 2 of 2008 article 6 paragraphs 2 and 3 stating that in addition to textbooks, educators can also use educator guide books, enrichment books, and reference books in the learning process. It is useful to increase the knowledge and insight of students, educators can encourage students to read enrichment books and reference books. This supplement book serves to increase knowledge about the excretory system in textbooks. Not only adding knowledge, this supplement book can also train students to think critically. That's because in this supplement book it is presented based on PBL syntax and is equipped with problems that exist in everyday life.

This developed supplement book is packaged in digital form so it is called an electronic teaching material supplement (e-teaching material supplement). This E-Supplement for teaching materials can maximize students' use of technology. In addition, this e-supplement is also easy for students to carry so that students can open and study whenever and wherever. Therefore, this e-supplement can make it easier for teachers to deliver material about life patterns that affect the disruption of the excretory system during learning.

This excretory system e-supplement is based on PBL syntax and principles so that it can encourage students to think critically in solving problems related to the human excretory system. This e-supplement is also equipped with pictures and colors so as to increase students' reading interest. If students' reading interest increases, then students will easily understand the concepts in the material. With the supplement of teaching materials on the excretory system material, students are expected to be able to understand healthy and unhealthy lifestyles. The better students' understanding of healthy lifestyles, students will also be able to analyze lifestyles that can cause abnormalities in tissues and organs in the excretory system. In addition, students can also solve problems and find solutions related to problems in the human excretory system because this supplement is based on PBL (problem-based learning).

Based on the background of the research, it needs to be studied in depth the validity, readability, and effectiveness of PBL-based e-supplement teaching materials on excretory system materials. The e-supplement for teaching materials is expected to improve the critical thinking skills of high school students.

## RESEARCH METHOD

This research was carried out at SMA Negeri 1 Jakenan using the research method Research and Development (R&D) according to Sugiyono (2015) which has been modified. The indicators measured in the study were the validity, readability, and effectiveness of PBL-based e-supplement teaching materials. The validity of the e-supplement of teaching materials is determined from the validation of material experts, media experts, and biology teachers. Meanwhile, the readability of e-supplements for teaching materials was determined from the responses of nine students of class XI and a biology teacher. The effectiveness results were determined from the classical completeness test and the N-Gain test. E-supplements teaching materials are said to be valid if the percentage of validity that can be reached > 62% with valid to very valid criteria. E-supplement teaching materials can be used for testing if the percentage of readability scores > 62.51% with good to very good criteria. E-supplement teaching materials are declared effective if the test scores of students show 75% of students reach the KKM limit (KKM score = 70) and the percentage of students who are within the criteria for the medium to high N-Gain score is 76%.

## RESULT AND DISCUSSION

### The Validity of PBL-Based Teaching Material E-Supplements on Excretory System Materials

The e-supplement validity test was carried out using a validation questionnaire by two biology lecturers at FMIPA UNNES and one biology teacher at SMA N 1 Jakenan. The test of the validity of e-supplements for teaching materials is divided into four aspects, namely aspects of the feasibility of E-

supplements of PBL-based teaching materials on excretory system materials were validated by expert validators, namely material experts, media experts, and biology teachers. The media expert and material expert who validated the product was a biology lecturer at the State University of Semarang. The teacher who validated the product was a biology teacher at SMA N 1 Jakenan.

The validity of the e-supplement material for excretory system teaching materials based on PBL is the result of validation from a material expert, namely a biology lecturer at the State University of Semarang. The material components consist of: content feasibility component, presentation component, and linguistic component. Details of the results of the assessment by material experts can be seen in table 1.

**Table 1** Validity of E-Supplement for PBL-based Excretion System Teaching Materials

No.	Assessment criteria	Score (%)
1.	Content eligibility components	80.8
2.	Serving components	84.4
3.	Components of language	88.9
	Average score	84.7
	Criteria	Very valid

Table 1 shows the results of the validity of the material, namely 84.7% with very valid criteria. This means that the PBL-based teaching material e-supplements that have been developed already meet the criteria and can be used in the learning process with some improvements. Apart from material experts, e-supplements were also validated by media experts, namely a biology lecturer at the State University of Semarang. The media component consists of a graphic component, namely the size of the teaching material, the cover design of the teaching material, and the design of the content of the teaching material. Details of the results of the assessment by media experts can be seen in table 2.

**Table 2** Validity of E-Supplement for PBL-based Excretion System Teaching Materials

No.	Assessment criteria	Score (%)
1.	Size of teaching materials	100
2.	Cover of teaching materials	96.4
3.	Teaching material content design	91.2
	Average score	93.3
	Criteria	Very valid

E-supplement of PBL-based teaching materials on the excretory system material reached a score of 93.3% with very valid criteria. This means that the PBL-based teaching material e-supplements that have been developed already meet the criteria and can be used in the learning process with some improvements. In addition to validation from two expert lecturers, e-supplement teaching materials were also validated by a class XI biology teacher at SMA N 1 Jakenan. The assessment component consists of: content feasibility, presentation, language, and graphics. The details of the assessment results by class XI high school teachers can be seen in table 3.

**Table 3** Validity of E-Supplements for PBL-based Excretion System Teaching Materials by Class XI Teachers

No.	Assessment criteria	Score (%)
1.	Content eligibility	70
2.	Presentation	100
3.	language	87.5
4.	Graphics	89.6
	Average score	87
	Criteria	Very valid

Based on table 3, it shows that the PBL-based e-supplement teaching materials that have been developed already meet the criteria and are valid. This is because in the preparation of E-supplements, teaching material supplements pay attention to the assessment standards for textbooks compiled by BSNP so that e-supplements of teaching materials have met the requirements to become textbooks. Supplementary teaching materials in quality learning pay attention to the components set by the National Education Standards Agency (BSNP), namely the components of the feasibility aspects of content, presentation, language, and graphics.

The aspect of content feasibility includes four indicators of the suitability of the material with KD,

material accuracy, material updates, and encouraging critical thinking. Based on the content feasibility test analysis that has been carried out, valid criteria are obtained. This is because the preparation of the material has been adjusted to KD 3.9 and KD 4.9. According to Magdalena et al. (2020) , in the process of developing a teaching material, its content must be adapted to the current curriculum and according to student needs. Apart from being adapted to KD 3.9 and KD 3.9, the concepts and definitions presented do not give rise to many interpretations. Facts, data, examples, cases, and pictures are presented in accordance with reality and are very efficient to improve students' understanding. Then the description of the material and examples of cases presented are able to foster curiosity so that it encourages students to think critically and find out more. This is what makes the feasibility aspect of the content of e-supplement teaching materials valid.

The presentation aspect has four indicators, namely presentation techniques, presentation support, learning presentations, and coherence and coherence in the flow of thought. Based on the analysis that has been done, the criteria are very valid. This is because the message or material presented is based on the stages of PBL so that students will think in a coherent, directed, systematic and critical manner. This is in accordance with the opinion of Ayuningrum et al. (2015) , in learning using PBL, students' thinking processes are directed coherently and systematically as well as building new knowledge, developing critical thinking skills, and problem solving skills.

The linguistic aspect has five indicators, namely straightforward, communicative, dialogical and interactive, conformity to the development of students, and conformity to language rules. Based on the analysis that has been done, the criteria are very valid. This is because the language used is very easy to understand, in accordance with the cognitive development of students, in accordance with the rules of Indonesian, very in accordance with the intellectual development of students, and able to motivate students. As many as 81.6% of the total students of class XI-MIPA 1 and XI-MIPA 2 stated that e-supplement teaching materials use language that is easy to understand so as to motivate students to study excretory system materials. This is in accordance with the opinion of Suswina (2011) that good teaching materials are expected to motivate students to read, do their assignments, and create students' curiosity to carry out further exploration of the material being studied.

The graphic aspect consists of three indicators, namely the size of the teaching materials, the cover design of the teaching materials, and the design of the content of the teaching materials. Based on the analysis that has been done, the criteria are very valid. This is because the size of the teaching materials is in accordance with the ISO standard, which is 210 x 297 mm. In addition, the appearance of the layout elements on the cover is consistent and harmonious, the composition of the layout is balanced and in tune with the layout of the content, the letters used are attractive and easy to read, and the typefaces used are not many. This was also supported by 80.2% of students from class XI-MIPA 1 and XI-MIPA 2 who thought that the cover display and e-supplement design of teaching materials were attractive. The Biology teacher of SMA Negeri 1 Jakenan also stated that he strongly agreed about the cover and design of interesting e-supplements for teaching materials. In the content of teaching materials, the placement of the layout elements is consistent based on the pattern, the placement (title, subtitle, and picture) does not interfere with understanding, typography makes it easier to understand, the pictures are interesting and clarify the material, and the colors are not flashy. This is in accordance with opinion of Ulfah (2017) that striking bright colors can interfere with reading writing.

The materials and concepts contained in e-supplements of teaching materials need to be validated so as not to cause misunderstandings, wrong concepts, and misunderstandings in studying the material. The material taken in the e-supplement of teaching materials comes from journals and books that can be accounted for. This e-supplement for teaching materials is used as a provider of various information and knowledge needed to develop various desired abilities in excretory system materials. To better understand the information, the language used is adapted to the cognitive development of high school students so that it is easier for students to understand the material because they can build their own concepts. Students not only learn by memorizing but build and understand their own concepts so that student learning becomes

meaningful (Nurmayani et al., 2018) . This was supported by 82.3% student responses which stated that PBL-based e-supplement teaching materials were easy to use and appropriate to the level of student development.

In addition to material assessment, the media assessment component is also important to be tested because good and good media will attract students' reading interest. This is in accordance with the research of Korniwati et al. (2016) that the selection of attractive, harmonious colors, does not interfere with concentration, and uses easy-to-read font types and sizes to make the teaching materials developed valid. As many as 80.9% of students from all students of class XI-MIPA 1 and XI-MIPA 2 stated that the PBL-based e-supplement of teaching materials used in excretory system learning could increase students' interest in learning and curiosity. If students' interest in learning increases, students will more easily understand the concepts of the excretory system material.

This teaching material supplement is in electronic form. This makes distance learning easier. This is supported by the teacher's response stating that this e-supplement teaching material makes it easier for students to study independently or in groups. The advantages of teaching materials in electronic form are practical, easy to carry, easy to access, and increase student motivation to learn. One of the advantages of this e-supplement for teaching materials is that it presents information in text form and is equipped with pictures to make it easier for students to understand the information or material. This is supported by 83.7% of students who think that the pictures in the e-supplement teaching materials are clear and interesting so that it increases students' motivation in learning. Media in the form of images aims to attract attention, clarify material, and illustrate facts and information (Kustandi and Sujipto, 2013).

Learning resources such as e-supplements of PBL-based teaching materials on excretory system materials play an important role in achieving basic competencies. The presentation of the material in the e-supplement of teaching materials is presented in a concise manner and not too long in description so that students do not get bored easily while reading and are encouraged to learn more deeply. This is also in accordance with the statement of Rahmawati et al. (2013) that students prefer interesting reading with few descriptions or descriptions and lots of pictures or colors .

PBL-based teaching material e-supplements that have been developed already meet the criteria and can be used in the learning process with some improvements. The suggestions and improvements from the validator are presented in table 4.

**Table 4** The result of the revision of the validity of PBL-based teaching materials for e-supplements on excretory system materials

No.	Validator	Validator Suggestion	Revision
1.	Theory Expert	Some sentences do not need to be given a background image	Remove unnecessary background images in some sentences
2.		If there are photos of kidney anatomy for a clearer picture	Changed the anatomy of the kidney for a clearer picture
3.	Media Expert	The concepts map is replaced with a material map/chart, because the chart is book material mapping chart	Change concept map to material map
4.		On several description pages, the description are still too long, so that they are less efficient in interpreting the phenomena described. It is better illustrated in a diagram and the narrative description is not too long.	Make material description that are still too long to be more effective and efficient
5.	Biology	Fix typo	Fixed typo
6.	Teacher	For each discussion topic, complete with an internet link as an additional reference that can be accessed by student	Added "Jelajah Link" in each discussion topic as an additional student reference
7.		Add disorders of the excretory system to the skin and lungs	Added skin disorders, namely <i>Acne vulgaris</i> and disorders of the lungs, namely pulmonary tuberculosis

Based on table 4, it can be concluded that several revisions from material experts, experts, media, and high school biology teachers were carried out so that e-supplements of teaching materials were better and could be used in the research process.

### Readability of PBL-Based Teaching Materials E-Supplements on Excretory System Materials

The readability test was carried out by distributing questionnaires to the biology teacher of class XI SMA Negeri 1 Jakenan and 9 students of class XI MIPA 2 SMA Negeri 1 Jakenan with the criteria of 3 students with high abilities, 3 students with moderate abilities, and 3 students with low abilities. Before filling out the questionnaire, the teacher and the 9 students were invited to read and observe the PBL-based e-supplement of teaching materials on the excretory system material as a reference for filling out the questionnaire. The results of the assessment of 9 class XI students on e-supplement teaching materials can be seen in table 5 below:

**Table 5** Results of the percentage of readability test questionnaires by students

No.	Valuation Details	Percentage
1.	Instructions for using PBL-based e-supplements for excretory system materials are clear and easy to understand	88,9%
2.	The pictures presented are clear and attractive	88,9%
3.	The use of fonts in PBL-based e-supplements for excretory system materials is clear and easy to read	97,2%
4.	The cover design of the PBL-based e-supplement for excretory system materials was interesting, which prompted me to study this teaching material.	72,2%
5.	The presentation of pictures and illustrations in the PBL-based e-supplement for excretory system materials made it easier for me to understand the material.	75%
6.	The proportion of colors used was appropriate and balanced.	80,6%
7.	Presentation pictures, layouts and colors in the PBL-based e-supplement of excretory system materials look harmonious, attractive and clearly visible	69,4%
8.	The sentence structure in the PBL-based e-supplement of excretory system materials is effective or uncomplicated	86,1%
9.	The learning materials used in e-supplement of PBL-based teaching materials excretory system materials related to daily life	86,1%
10.	Cases or problems presented are related to problems of daily life	88,9%
11.	Presentation of materials encourages critical thinking	80,6%
12.	Presentation of materials in e-supplements of PBL-based teaching materials coherent excretory system material so it doesn't make me feel confused	88,9%
13.	The language used and the use of scientific terms in the e-supplement of PBL-based teaching materials for the excretory system material is simple and easy to understand	86,1%
14.	The language used encourages students to master the excretory system material	72,2%
15.	The language used is in accordance with what students need	88,9%
16.	Presentation of the material In the e-supplement of PBL-based teaching materials, the excretory system material is presented clearly and in detail	75%
17.	The language used is straightforward and easy to understand	86,1%
18.	The language used is communicative	91,7%
19.	Presentation of material in PBL-based e- supplements of excretory system materials arouse more curiosity	88,9%
20.	The sentence used represents the content of the message or information to be conveyed	77,8%
<b>Average percentage</b>		<b>83,5%</b>
<b>Criteria</b>		<b>Very good</b>

Table 5 shows the results that the e-supplement of teaching materials developed obtained a percentage of 83.5% with very good criteria. This is because E-supplements for teaching materials use sentence structures that are in accordance with Indonesian language rules, are effective, and are not complicated. The language used is in accordance with the cognitive development of students, straightforward, communicative, and easy to understand. In addition, the type of writing used is also minimal so that it does not interfere with students in studying the contents of e-supplement teaching materials. This is in accordance with the opinion of Syamsi et al. (2013), that the typography used does not contain ornamental and excessive letters.

### The Effectiveness of PBL-Based Teaching Material E-Supplements on Excretory System Materials

The effectiveness of e-supplement teaching materials can be seen from several indicators. The indicators of effectiveness used in this study were classical completeness and an increase in the N-Gain test. These two indicators are fully described in the following sub-chapters.

### Classical Mastery Test Results

E-supplements teaching materials are declared effective if the test scores of students show 75% of students reach the KKM limit (KKM score = 70). The percentage of classical completeness is presented in table 6.

**Table 6.** Classical completion of class students of class XI-MIPA 1 and XI-MIPA 2 SMA Negeri 1 Jakenan

Information	XI-MIPA 1	XI-MIPA 2	Average
Classical completeness	75%	81%	78%

Based on the data in table 6, it is known that 78% classical completeness of students is able to achieve the specified KKM of 70. These results indicate that learning with PBL-based teaching materials supplementation is effective on students' critical thinking skills. That matter This is because the presentation of material is in accordance with everyday problems and is equipped with representative images so that students can understand the concept of the material correctly. This is in accordance with the statement of Hidayah et al. (2021), that teaching materials that are presented completely and accompanied by pictures can prevent misunderstandings of concepts. Increased student understanding makes students' critical thinking skills increase.

The success of measuring students' critical thinking skills is observed from the learning outcomes obtained after carrying out learning using e-supplements of PBL-based teaching materials. The results of critical thinking are obtained from working on the problems contained in e-supplement teaching materials. E- supplement teaching materials contain problems that will be studied by students and then analyzed to find solutions to the problem. From the results of the analysis, students will answer the questions that have been provided.

In addition to working on problems that exist in e-supplement teaching materials, students' critical thinking skills will be seen in working on posttest questions. Posttest questions are prepared by taking into account critical thinking indicators, namely providing simple explanations, forming basic skills, concluding, providing further explanations, and setting tactical strategies. The more scores collected, the more students will criticize the problem and find solutions to answer the questions provided. The scores collected will be used as the success of the students' critical thinking level. The collected scores are then tested for classical completeness. Class XI-MIPA 1 got 75% classical completeness while class XI-MIPA 2 got 80.5%.

There is a difference in classical completeness between classes XI-MIPA 1 and XI-MIPA 2. This is due to the different character of students in XI-MIPA 1 and XI-MIPA 2. Students in class XI-MIPA 2 are more enthusiastic and interested in participating in learning. This is indicated by the activeness of students in answering the teacher's questions during the learning process. Even though the lesson was in the last lesson, class XI MIPA 2 was still enthusiastic in listening to and understanding the teacher's explanation. Discussion time In discussing problems in e-supplement teaching materials, students in class XI-MIPA 2 are more active in asking and answering so that students are more critical and understand the material. It is this attitude and character that causes differences in the critical thinking abilities of XI-MIPA 1 and XI-MIPA 2 students. This is in accordance with the opinion of Mulyani (2013) which states that basic abilities, talents, interests, motivation, attitudes, and study habits affect success or student failure. Student activity plays an important role in improving students' critical thinking skills. This is supported research by Dewi (2020), activeness can foster a critical thinking attitude which will have an impact on more and more knowledge gained in accordance with their curiosity.

### Improvement of Critical Thinking Ability Based on N-Gain Test

E-supplement teaching materials are declared effective if the percentage of students who are in the medium to high N-gain score criteria is 76%. The results of the N-Gain calculation can be seen in table 7.



**Table 7** Calculation (N-Gain) of students

Information	XI-MIPA 1	XI-MIPA 2	Average	Criteria	Percentage of students who are in the medium until high N-Gain score
N-Gain result	0,54	0,55	0,549	Medium	81,94

Based on table 7, it can be seen that the percentage of students who are in the N-Gain score criteria are moderate to high by 81.94%. These results indicate that the e-supplement of PBL- based teaching materials on the excretory system material is effective on the critical thinking skills of high school students.

Critical thinking ability according to Shanti et al. (2017) is an ability consisting of important elements such as interpreting, analyzing, evaluating, and making a decision to solve the problem. The critical thinking ability indicators studied were providing simple explanations, building basic skills, concluding, providing further explanations, and setting strategies and tactics. The data from the recapitulation of the indicator values for students' critical thinking skills are presented in table 8 below.

**Table 8** Results of Recapitulation of Critical Thingking Ability Indicator values

Indicator Ability Critical Thinking	XI-MIPA 1		XI-MIPA 2		Overall Class Average	
	Pretest	Posttest	Pretest	Posttest	Pretest	Posttest
1	32,41	71,30	35,19	73,15	33,80	72,22
2	28,70	60,19	24,07	69,44	26,39	64,81
3	27,38	62,30	26,59	61,11	26,98	61,71
4	53,70	79,63	41,67	78,70	47,69	79,17
5	33,33	81,94	49,31	79,86	41,32	80,90
<b>Average</b>	<b>35,11</b>	<b>71,07</b>	<b>35,36</b>	<b>72,45</b>	<b>35,23</b>	<b>71,76</b>
<b>Criteria</b>	<b>Less critical</b>	<b>Critical</b>	<b>Less critical</b>	<b>Critical</b>	<b>Less critical</b>	<b>Critical</b>

Based on Table 6, it can be seen that the students of class XI-MIPA 1 and XI-MIPA 2 belong to the class XI-MIPA 1 and XI-MIPA 2 in students with critical criteria. This is because the presentation of material based on the PBL syntax is where students are trained to find a solution to a problem so that the ability to think critically students increase. This is supported by the statement of Yarid & Ariswan (2016) that in PBL syntax contains activities where students are required to make observations and collect data so it is necessary to apply learning methods that facilitate these activities. Students are sued to use their thinking skills to answer the problems provided so that a concept is formed so that critical thinking skills are formed (Yulianti & Gunawan, 2019).

## CONCLUSION

Based on the results of research and discussion, it can be concluded that e-supplement teaching materials PBL based on excretory system material is very valid, reads very well, and is effective for improving critical thinking skills of high school students

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