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# Development of the Assessment to Measure the Critical Thinking Ability of the Blood Circulation Systems for Humans in Bengkulu City

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## *Abstract*

This study determined the validation, practicality, feasibility, reliability coefficient, level of difficulty and the distinction between critical thinking based assessment to measure student critical thinking skills. This research uses a research and development type with a quantitative approach. This research procedure uses the Borg & Gall development model, which includes 8 steps, namely potential problems, information gathering, product development, expert validation, expert revision, small-group testing, product revision, final product. The research instruments used were questionnaires, interviews, and documentation. The subjects of this study were students of class VIII SMPN 8, SMPN 10, SMPN 22 Bengkulu City. The results showed that the results of the assessment instruments carried out met the criteria of valid, reliable, practical, feasible, had distinctive power, scoring questionnaires and the level of difficulty that was spread with the normal level of data distribution. This research is in the field of natural sciences that can be used by science subject educators to make a positive contribution to the development of natural sciences, particularly in junior high schools, MT equivalents and B non-formal education. This study is different from previous studies and is considered to be different from other studies.

***Keywords:*** *Assessment; Critical Thinking; High Order Thinking Skill*

## *Introduction*

In accordance with the Regulation of the Minister of Education and Culture No. 64 of 2013 concerning Basic and Secondary Education Content Standards to meet future needs and welcome the Golden Generation of Indonesia in 2045, has established Graduate Competency Standards based on XXI Century Competencies, that learning in the 21st century must be able to develop competitive skills that focus on development of higher order thinking skills, one of which is critical thinking (Abidinsyah et al., 2019).

Critical thinking is a skill of reasoning and reflective thinking that focuses on determining what is believed to be. Critical thinking is also a skill that can be developed during the learning process (Hasyim & Andreina, 2019). Critical thinking skills are the thinking skills of students that are very important to develop in educational institutions so that Indonesia can compete globally in the 21st century. There are four competencies that students must have in order to compete in the 21st century, namely critical thinking and problem solving, creativity, communication skills (the ability to communicate) and the ability to work collaboratively (Fanani, 2018).

According to Senrot Kusairi, students' critical thinking skills can be trained through learning by asking questions that contain critical thinking categories. However, there are still teachers who have difficulty asking these critical questions of thought (Jazuli et al., 2020). This is due to the limited time that the teacher has to compile the questions, as well as the lack of understanding of the teacher in compiling the critical thinking questions properly. The quality of learning is determined, among other things, by the quality of the assessment carried out by the teacher in the learning process (Primayana, 2019).

Learning assessment is one of the elements used to determine the extent to which student competence is achieved and the effectiveness of the learning process carried out to achieve learning objectives (Hartina et al., 2019). Learning assessments must be carried out in such a way that they can find out what they have learned or show what they have not learned (Studies & Bilgiler, 2020). Assessment is important to 1) clarify, share, and understand learning objectives, 2) conduct discussions, effective learning and produce evidence of learning, 3) obtain feedback so that learning is better, 4) activate students as sources of learning from each other, and 5) activate students as owners of their own learning (Arikunto, 2013).

Based on the results of interviews and observations that have been carried out with several teachers in junior high schools throughout Bengkulu City, it shows that the schools where they teach use the 2013 Curriculum system (Pradani & Artikel, 2018). Where the curriculum seeks to perfect the mindset of students to become more critical (Yahfenel., 2018). In addition, other research findings also show that the assessment used so far has not yet measured the critical thinking skills of students, which can be seen from the questions used by the teacher in evaluating students, only to measure aspects of knowledge, not at the level of critical thinking skills (Hasyim & Andreina, 2019).

The results of observations that have been made on learning science about the interaction of living things with their environment are various kinds of exam questions consisting of Daily Repeat questions (UH), Mid-Semester Exams (UTS), Final Semester Examinations (UAS), National Examinations (UN) , as well as the Package Book. Which shows that the questions that empower students to think critically in SMP in Bengkulu City consist of SMPN A by 12%, SMPN B by 10%, and SMPN C by 8% which consists of 100 items in SMP in Bengkulu. This is due to the fact that there are very few indicators of critical thinking skills found in the examination questions, mostly in the assessment, there are many questions that only measure basic skills, such as the types of questions that measure aspects of student knowledge only in the form of questions C1, C2 and C3. This shows that the critical thinking skills of students at junior high schools in Bengkulu City are still categorized as low. One of the factors is the difficulty of the teacher in asking questions for the category of critical thinking (Suryawati et al., 2018).

On the basis of the above background, it is necessary to develop an assessment that can measure the critical thinking skills of students, and therefore the research with the title is carried out “Development of the assessment to measure the critical thinking ability of the blood circulation systems in humans in Bengkulu city”.

## *Method*

The type of research used is development or research and development (R&D) with a quantitative (Temanggung, 2018) Research and development is a research method used to produce and test the efficacy of certain products (Fadhilaturrahmi & Ananda, 2018). To be able to produce some of the products used for research that is useful in the wider community, so that research is needed to test these products. The product developed is a test item based on critical thinking skills for the interaction of living things with the environment (Masitoh & Aedi, 2020).

The procedure used in this study was the model developed by Borg & Gall. A process used for the development and validation of educational products (Mardianti et al., 2020). The phases of the research and development process usually form a consistent cycle for the production of a particular product according to needs, through the initial phase of product design, initial product testing to identify various weaknesses, retrieve, and improve until a product that is considered ideal is finally found (Efendi et al., 2020). Validation contains the word "logic" which means reasoning. Logical validation will therefore be based on the results of the reasoning. Valid conditions are considered to have been met because the instrument has been well designed. There are two types of logical validity, namely content validity and construct validity (Imania & Bariah, 2019).

The types of data collected in this development assessment are qualitative and quantitative data. Qualitative data were obtained from suggestions and corrective input from assessment experts, material experts, linguists, students and teachers who would be analyzed later on. In the meantime, quantitative data were obtained from the initial product studies of the developed questions and the main products of the student's critical thinking questions (Sabdaningtyas, 2018).

The technique used to analyze the results of the student validation worksheets will be used by the researcher to make a validation sheet containing a statement (Bano, 2018). The validator then fills in the completed questionnaire by giving a check mark on the categories provided by the researcher on the basis of the Likert scale consisting of five assessment scores as follows:

**Table 1. Expert Validation Rating Score**

| Information | Score |
|---|---|
| Very good | 5 |
| Good | 4 |
| Enough | 3 |
| Less | 2 |
| Very less | 1 |

(Source: Parmin, 2021)

The validation results set out in the validation sheet for the development of the question assessment will be analyzed using the following formula:

$$N = \frac{k}{Nk} \times 100\%$$

The validity of the instrument in question uses the formula for the product moment correlation, namely:

$$r_{xy} = \frac{N\Sigma xy - (\Sigma x)(\Sigma y)}{\sqrt{\{N\Sigma x^2 - (\Sigma x)^2\}\{N\Sigma y^2 - (\Sigma y)^2\}}}$$

(Setiawan, 2017)

Based on the product moment correlation table with the rhit>rtab provisions. This means that the items are valid.

In addition, the percentage of the criteria for interpreting the validation score is based on the following table:

**Table 2. Criteria for Validation Score Interpretation**

| Interval Criteria | Criteria | Convertion |
|---|---|---|
| $86\% \leq N < 100\%$ | Very good | A |
| $72\% \leq N < 85\%$ | Good | B |
| $58\ \% \leq N < 71\%$ | Enough | C |
| $44\% \leq N < 57\%$ | Less | D |
| $N \leq 44\%$ | Very less | E |

(Sary, 2018)

Furthermore, the percentage of eligibility obtained is then interpreted into categories based on the following table:

**Table 3. Criteria for Eligibility**

| Apraisal | Interpretation Criteria |
|---|---|
| $81 \leq P \leq 100\%$ | Very Feasible |
| $61 \leq P < 81\%$ | Feasible |
| $41 \leq P < 61\%$ | Decent Enough |
| $21 \leq P < 41\%$ | Not Feasible |
| $0 \leq P < 21\%$ | Very Unworthy |

(Febrianto & Puspitaningsih, 2020)

Declared theoretically if the percentage of eligibility is ≥ 51%.

In addition, the teacher and the students complete the questionnaire, giving a check mark to the category given to the researcher on the basis of the Likert scale, consisting of five assessment measures, as follows:

**Table 4. Questionnaire Score**

| Answer options | Score answer options |
|---|---|
| Strongly Agree (SS) | 5 |
| Agree (S) | 4 |
| Disagree (KS) | 3 |
| Disagree (TS) | 2 |
| Strongly Disagree (STS) | 1 |

(Atmojo & Kurniawati, 2018)

The results of the answers to the questionnaire from teachers and students will be analyzed using the following formula:

$$p = \frac{f}{n} \times 100\ \%$$

Keterangan:

P: The percentage of the data on the questionnaire
F: Total score obtained by
N: The maximum number of scores available

The results of these percentages can then be grouped into the Likert Scale Scale Score Interpretation Criteria to draw conclusions on the responses of teachers and students, and the Likert Scale Scale Score Interpretation Criteria are as follows:

**Table 5. Criteria for Practical Interpretation**

| Assessment | Criteria for Interpretation |
|---|---|
| 81≤ P ≤ 100% | Very practical |
| 61 ≤ P < 80% | Practical |
| 41≤ P 60% | Quite Practical |
| 21 ≤ P < 40% | Impractical |
| 0 ≤ P < 21% | Very Impractical |

(Khairadi, 2020)

Reliability means that it refers to an understanding that an instrument can be trusted enough to be used as a data collection tool because it is good enough. The KR-20 formula is used to determine the reliability:

$$KR-20 = \frac{k}{k-1}\left[1-\frac{\Sigma p(1-p)}{SD^2}\right]$$

KR-20 = Reliabilitas Kuderson Richard
K = Number of items
p = Proportion of correct answers
SD = Standard deviation

The decision-making criterion is that if KR 20>0.6 then the research instrument is reliable (trustworthy) (Wang et al., 2020).

The level of difficulty in the small test results is shown by the percentage of the output of the Quest Program. The difficulty level category of the questions can be found in Table 6.

**Table 6. Category of Problem Level of Difficulty**

| Price P | Question Of Category |
|---|---|
| **0,00- 0,29** | Hard |
| **0,30- 0,69** | Moderate |
| **0,70- 1,00** | Easy |

(Handayani & Iba, 2020)

In this study the formula used to calculate the difference power of the questions is as follows:

$$\mathrm{DP} = \frac{JB_A - JB_B}{JS_A}$$

Information:
DP: The distinguishing power of the questions
JBA: The number of students who answered correctly on the items in the upper group
JBB: The number of students who answered correctly on the items in the lower group
JBA: The number of students in the upper group
The classification of the distinguishing power in this study is as follows:
DP = 0.00 is very bad.
0.00 <DP ≤ 0.20 is bad
0.20 <DP ≤ 0.40 is sufficient
0.40 <DP ≤ 0.70 is good
0.70 <DP ≤ 1.00 is very good
(Astuti et al., 2019)

## *Results and Discussion*

A. The results of the validation test

1. Logical validation 1.

Researchers tested the logical and empirical validation in the validation test. Logical validation is based on the validation results of the rationale of the validator. There were 15 questions with 6 types of questions tested for validity in the validation of each item. The validation test was carried out by the validator for approximately 3 weeks and the validator immediately gave valid results.

Its validity with some suggestions for improvement. The results of the validity of each item by the three validators, namely:

**Table 7. Question Validity**

| **Validator** | **Number of Question** | | | **Total Question** |
|---|---|---|---|---|
| | Valid | Less Valid | Invalid | |
| Validator 1 | 13 | 1 | 1 | 15 |
| Validator 2 | 10 | 3 | 2 | 15 |
| Validator 3 | 11 | 2 | 2 | 15 |

On the basis of the results of the logical validity of each item, only 10 questions could be used under conditions that were less valid had to be corrected. After each item has been validated, the validator validates the entire question by completing the validation questionnaire.

1. Validity of the items of question

The results of the analysis of the product validity using the product moment correlation test are shown in the following table:

**Table 8. Validity Testing**

| Item Number | R | Inf |
|---|---|---|
| 1 | 0.25 | Invalid |
| 2 | 0.59 | Valid |
| 3 | 0.54 | Valid |
| 4 | 0.36 | Valid |
| 5 | 0.13 | Invalid |
| 6 | 0.23 | Invalid |
| 7 | 0.13 | Invalid |
| 8 | 0.38 | Valid |
| 9 | 0.36 | Valid |
| 10 | 0.56 | Valid |
| 11 | 0.62 | Valid |
| 12 | 0.17 | Invalid |
| 13 | 0.70 | Valid |
| 14 | 0.38 | Valid |
| 15 | 0.62 | Valid |
| R Table 5% ; N 30 = 0.32 | | |

On the basis of the results of the validation test using the product moment correlation, it was found that the valid questions were questions 2, 3, 4, 8, 9, 10, 11, 13, 14, 15 and the invalid questions were questions 1, 5, 6, 7 and 12. The reason for the invalid questions in question number 1 was that the questions were so easy that many students answered correctly, while the rest were questions number 5, 6, 7 and 12, because few students answered the questions correctly.

**Table 9. Criteria for due diligence, Questionnaire score and Practicality**

| NO | Test Criteria | Type | Number of Respondent |
|---|---|---|---|
| 1 | Feasibility | Very Feasible | 2 |
| | | Feasible | 13 |
| | | Decent Enough | 4 |
| | | Not Feasible | 1 |
| | | Very Unworthy | 0 |
| | | **Number of Respondent** | **20** |
| 2 | Questionnaire | Strongly Agree | 4 |
| | | Agree | 10 |
| | | Simply Agree | 4 |
| | | Disagree | 2 |
| | | Strong Disagree | 0 |
| | | **Number of Respondent** | **20** |
| 3 | Practical Interpresentation | Very Practical | 3 |
| | | Practical | 15 |
| | | Quite Practical | 2 |
| | | Impractical | 0 |
| | | Very Impractical | 0 |
| | | **Number of Respondent** | **20** |

On the basis of the above table, it can be seen that the results of the feasibility test carried out on the question item instrument resulted in a distribution of data consisting of very feasible criteria chosen by 2 respondents, criteria which were eligible to be chosen by 13 respondents, criteria which were quite feasible to be chosen by 4 persons and none of the respondents who chose very unfit criteria (Khoirudin, 2019).

In addition, the results of the questionnaire distribution show that the criteria Strongly agreed are in the highest order of choice of respondents, i.e. 10 people, followed by 4 respondents who are quite in agreement and strongly in agreement, and the criteria for disagreement are chosen by 2 respondents (Wahyuni, 2018).

In the meantime, the practicality interpretation test shows that 15 respondents had chosen practical criteria, 3 had chosen very practical criteria and 2 had chosen quite practical criteria. The rest is that it is impractical and the choice is very impractical for the respondent not to choose (Wedyawati & Lisa, 2018)

B. Issue of reliability

The results of the analysis of the reliability of research data are presented in the following table:

**Table 10. Reliability Testing**

| Source | Score |
|---|---|
| K | 15 |
| $\Sigma p(1-P)$ | 2.56 |
| Standard Deviation | 2.46 |
| KR-20 = 0.618 | |

The results of the reliability analysis using the KR-20 formula are 0.618 KR-20. This is more than 0.6. This shows that the questions submitted as an instrument are reliable or reliable (Sugianto et al., 2018).

C. Difficulty level

The results of the analysis of the level of difficulty are presented in table 11.

**Table 11. Test the Level of Difficulty of the Questions**

| Question Number | Number of Correct Answers | Difficulty Level (DL) | Inf |
|---|---|---|---|
| 1 | 15 | 0.44 | Moderate |
| 2 | 30 | 0.88 | Easy |
| 3 | 15 | 0.44 | Moderate |
| 4 | 17 | 0.50 | Moderate |
| 5 | 3 | 0.09 | Hard |
| 6 | 5 | 0.15 | Hard |
| 7 | 11 | 0.32 | Moderate |
| 8 | 26 | 0.76 | Easy |
| 9 | 30 | 0.88 | Easy |
| 10 | 29 | 0.85 | Easy |
| 11 | 30 | 0.88 | Easy |
| 12 | 10 | 0.29 | Hard |
| 13 | 22 | 0.65 | Moderate |
| 14 | 21 | 0.62 | Moderate |
| 15 | 30 | 0.88 | Easy |

The results of the analysis of the difficulty level obtained by the group of questions included in the easy difficulty level category were questions 2, 8, 9, 10, 11 and 15. The group of questions with a moderate difficulty level were questions 1, 3, 4, 7, 13 and 14. Questions with a difficult level of difficulty are questions 5, 6 and 12 (yani, 2016).

C. Difference

The difference of power test is obtained by questions with bad difference of power are questions 1, 5, 6, 7, 12, sufficient difference of power is questions 2, 8, 9, 10, 11, 15, and good difference of power is questions 3, 4, 13 and 14. The results of the difference in questions analysis are presented in Table 12 (Studi et al., 2020).

**Table 12. Difference Power Testing Problem**

| Question Number | BA | BB | PA | PB | D | Ket |
|---|---|---|---|---|---|---|
| 1 | 9 | 6 | 0.529 | 0.353 | 0.176 | Ugly |
| 2 | 17 | 13 | 1.000 | 0.765 | 0.235 | Enough |
| 3 | 12 | 3 | 0.706 | 0.176 | 0.529 | Good |
| 4 | 12 | 5 | 0.706 | 0.294 | 0.412 | Good |
| 5 | 2 | 1 | 0.118 | 0.059 | 0.059 | Ugly |
| 6 | 4 | 1 | 0.235 | 0.059 | 0.176 | Ugly |
| 7 | 7 | 4 | 0.412 | 0.235 | 0.176 | Ugly |
| 8 | 15 | 11 | 0.882 | 0.647 | 0.235 | Enough |
| 9 | 17 | 13 | 1.000 | 0.765 | 0.235 | Enough |
| 10 | 17 | 12 | 1.000 | 0.706 | 0.294 | Enough |
| 11 | 17 | 13 | 1.000 | 0.765 | 0.235 | Enough |
| 12 | 6 | 4 | 0.353 | 0.235 | 0.118 | Ugly |
| 13 | 16 | 6 | 0.941 | 0.353 | 0.588 | Good |
| 14 | 15 | 6 | 0.882 | 0.353 | 0.529 | Good |
| 15 | 17 | 13 | 1.000 | 0.765 | 0.235 | Enough |

## *Conclusion*

Based on the research results, it can be seen that the validity of the test development logically shows that the test is very valid, and the test is good to use. Furthermore, it can also be seen that the question instrument is in the feasible, practical category and the respondent agrees with the question instrument being developed. The validity test also shows that the number of valid questions is 10 items and 5 invalid items. Reliability test shows that the question instrument is reliable or reliable because r count is greater than r table (0.600) which is equal to 0.618. The conclusion level test shows that the number of easy items is 6, medium 6 and difficult 2. The Difference Power Test illustrates that the number of bad questions is 5, enough is 6 and is good 4.

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