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E-Diagnostic Based on Multirepresentation to Know Cognitive Ability in Excretion System Learning

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ABSTRACT
Pandemic requires educators to be more creative in presenting online learning so that students can receive learning well. The researcher developed an E-diagnostic test, the presentation of the questions contained a representation of the Excretory System material. This study aims to determine the feasibility of multi-representation-based E-diagnostics in measuring students' cognitive abilities. The type of research used is the development (Research and Development) by adopting the stages. The research was conducted in seven stages: potential and problems, data collection, product design, design validation, design revision, product testing, and product revision. The research instruments were in the form of interview sheets, validation sheets, and test results. Data collection techniques in the form of interview sheets, validation questionnaires, and tests. Data analysis in this study included: learning outcomes tests, item validity, and item reliability. The results of the study were in the form of test results for students of class XI IPA-A and XI IPA-B who scored above the average of 20 from each class. The test results of the validity of the questions from the validator's assessment are 2.66 with quite valid criteria and the question instrument that shows more than 0.3 is included in the valid category. The result of the product moment correlation test is 0.6 with a strong category. The results of the reliability test of more than 0.60 are categorized as reliable so that based on the test results, the test is feasible to use in knowing the cognitive abilities of students.

***Keywords**: E-Diagnostic; Multi-Representation; Cognitive Ability.*

INTRODUCTION
The Covid-19 pandemic period requires educators to create interesting learning media to make it easier for students to learn online. Syah (2020) stated that schools must force themselves to use online media, but the use of online media has many obstacles. Educators tend to have a habit of using the lecture method and require students to memorize and work on questions without guidance (Desmita, 2016). This learning hinders students' higher-order thinking skills, especially critical thinking skills (Irawati, 2015). Continuous learning will be boring and make students lazy to learn so that researchers will create more interesting learning media. Researchers will make tests to test how far the level of knowledge of students. Diagnostic tests to find out the strengths and weaknesses of students and to improve the teaching and learning process (Zhao, 2013). This test is used to determine the learning difficulties faced by students. Wardhani (2012) states that web-based diagnostic tests are to quickly and accurately diagnose student learning difficulties. The website used in this research is google form. Suhandi and Wibowo (2012) state that multiple representations are used in interactive conceptual learning programs in instilling conceptual understanding. Multi-representation includes ways to express a concept in verbal, graphic, and mathematical forms (Waldrip et al., 2006); (Fauziah et al, 2018). In this study, the questions presented were in the form of multiple representations, such as pictorial questions about the structure of the skin, kidneys, urea formation diagrams, and liver excretion schemes (Ami et al, 2019).

Vidayanti (2017) cognitive abilities, including the ability to improve students' thinking skills. Hardianti (2018) states that cognitive abilities are important in knowing the achievement of learning outcomes and the level of achievement of students' cognitive abilities. The study was conducted to determine the cognitive abilities of students and to determine the feasibility of the validity of the items.

So the researchers developed this research with the title E-Diagnostic Based On Multirepresentation To Know Cognitive Ability In Excretion System Learning.

METHOD

The development model in this research is R & D (Research and Development) by modifying the stages into seven stages. The first stage, analyzes the problems that occur during the pandemic such as the lack of interest of students in doing assignments so that it requires educators to create media that students like. The second stage is collecting data by interviewing Biology teachers. The third stage, preparing a design plan, begins with collecting Excretion System material questions where the questions made contain elements of representation. The fourth stage, Validation is carried out by the Biology teacher as a material expert. Validation results to improve test questions if there are errors in their preparation. The fifth stage, product revision based on the validation results. The sixth stage, trial and error directly in one school. The seventh stage, the second design revision is special if the e-diagnostic test questions do not occur completely.

This study will test the cognitive abilities of students in class XI IPA-A and XI IPA-B at MAN Megaluh with 34 students in each class. Data collection instruments used include interviews, questionnaires and test results. Interviews to find out the existing problems, questionnaires for the assessment of material experts as question validators and learning outcomes tests were obtained from direct test tests.

Data analysis techniques used in this study.

- The learning outcomes test was analyzed to determine the completeness of the achievement of student learning outcomes based on the minimum completeness criteria (KKM) at MAN Megaluh, which was 75.

$$SCORE = \frac{total\ student\ scores}{maximum\ score} \times 100$$

- Item Validity Analysis
  - Logical Validity

    The e-diagnostic test questions will be validated by the Biology teacher by assigning a score to each item with answers very appropriate (4), appropriate (3), quite appropriate (2), less appropriate (1), and not appropriate (0). The total score will be added up using the formula:

$$\bar{X} = \frac{\sum_{i=1}^{n} x_i}{n}$$

    (Putra, 2016)

    Description:

    $\bar{X}$ = final average

    x_i = the ideal value of the questionnaire for each aspect

    n = number of arrangements
  - Empirical Validity

    The e-diagnostic test items will be tested for validity using the product moment correlation formula by class XI IPA-A and XI IPA-B at MAN Megaluh. The following formula is used:

$$r_{xy} = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{[N\sum X^2 - (\sum X)^2][N\sum Y^2 - (\sum Y)^2]}}$$

    (Sugiyono, 2019)

    Description:

    r_{xy} = searched correlation coefficient

    N = number of test takers

    X = variable value X (item score)

    Y = Y variable value (item score)

    To test the validity of each item, it is done by looking for the correlation between each item and the total value. If rcount>rtable then the item is valid. A valid instrument if the correlation is above 0.30 if below 0.30 then the instrument is not yet valid (Sugiyono, 2017).
- Question reliability analysis

  The reliability of the questions can be measured using the Cronbach Alpha formula:

$$r_{11} = \left(\frac{k}{k-1}\right)\left(1 - \frac{\sum {\sigma_b}^2}{{\sigma_t}^2}\right)$$

(Sugiyono, 2019)

Description:

r_{11} = question reliability
k = number of questions
$\Sigma {\sigma_b}^2$ = number of item variances
${\sigma_t}^2$ = total variance

So, the question is said to be reliable if r_{11} is more than equal to 0.600 less than that it is said to be unreliable (Sugiyono, 2017).

RESULT AND DISCUSSION

The results of the development of this assessment obtained data in the form of the average student learning outcomes as well as the validity of the items and the reliability of the items. If the learning outcomes obtained are above average, the cognitive abilities of students are quite good. Items are valid if the rcount is more than 0.3 and is declared reliable if r_{11} is more than equal to 0.600.

Result

- Learning Outcomes Test Analysis

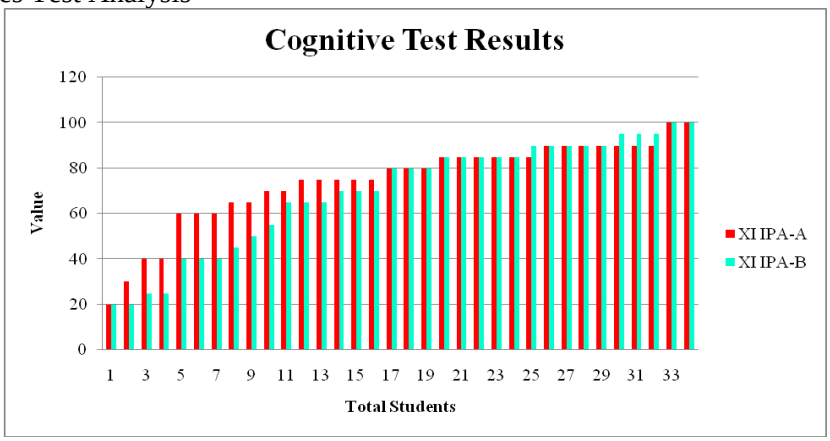

Figure 1. Cognitive Test Results

The learning outcomes in this study were in the form of cognitive test results for class XI IPA-A and XI IPA-B with a total of 34 students in each class. Here's the link for working on the E-diagnostic test: https://forms.gle/d9Hzt3SDXLGNsLVM7.

- Item Validity Analysis
  - Logical Validity

Tabel 1. Logical Validity

Rating Score	0	1	2	3	4
Rating Category	It is not in accordance with	Not suitable	Quite appropriate	Corresponding	Very suitable

(Riyani, 2017)

Logical validity will see the validity based on the results of the validator's assessment (Riyani, 2017). The validation sheet contains 12 aspects related to the suitability of the content of the material, subject matter, answers and multi-representation images.

  - Empirical Validity

The results of the empirical validity of each item, the question is said to be valid if rcount is greater than rtable.

Table 2. Validity Test Results for Class XI IPA-A

No.	Rcount	Rtable	Description
1.	0,53	0,3	V
2.	0,43	0,3	V
3.	0,03	0,3	IV
4.	0,59	0,3	V
5.	0,67	0,3	V
6.	0,38	0,3	V
7.	0,49	0,3	V
8.	0,53	0,3	V
9.	0,32	0,3	V
10.	0,67	0,3	V
11.	0,31	0,3	V
12.	0,53	0,3	V
13.	0,6	0,3	V
14.	0,554	0,3	V
15.	0,32	0,3	V
16.	0,15	0,3	IV
17.	0,57	0,3	V
18.	0,3	0,3	IV
19.	0,706	0,3	V
20.	0,66	0,3	V

Table 3. Validity Test Results for Class XI IPA-B

No.	Rcount	Rtable	Description
1.	0,69	0,3	V
2.	0,56	0,3	V
3.	0,69	0,3	V
4.	0,5	0,3	V
5.	0,37	0,3	V
6.	0,21	0,3	IV
7.	0,69	0,3	V
8.	0,38	0,3	V
9.	0,72	0,3	V
10.	0,74	0,3	V
11.	0,36	0,3	V
12.	0,69	0,3	V
13.	0,62	0,3	V
14.	0,72	0,3	V
15.	0,56	0,3	V
16.	0,26	0,3	IV
17	0,59	0,3	V
18	0,47	0,3	V
19	0,74	0,3	V
20	0,37	0,3	V

Description:
V = valid
IV = invalid

- Question reliability analysis
  In addition to looking at the validity of the items, in order to produce good questions, they are tested for reliability. Reliability testing is carried out using the Cronbach Alpha formula, namely r_{11} (Sugiyono, 2019).

Discussion

- Learning Outcomes Test Analysis
  The learning outcomes in this study were in the form of cognitive test results for class XI IPA-A and XI IPA-B. Based on the analysis conducted, Class XI IPA-A obtained an average of 74.5 and class XI IPA-B obtained an average of 69.5. Minimum completeness criteria (KKM) in Biology subjects at

MAN Megaluh is 75. Based on the test results of class XI IPA-A and XI IPA-B who get scores above KKM as many as 20 students Students who score above the average mean they have good cognitive abilities and have a tendency to receive information in visual learning (eg diagrams, pictures, and graphs) (Winarso, 2017).

- Item Validity Analysis
  - Logical Validity
    In the validity test, the researcher tested the logical validity and empirical validity. Logical validity is based on the results of the validator's assessment (Riyani, 2017). The results of the validator assessment obtained an average of 2.66 included in the fairly valid category but some need revision (Pratama, 2016). In addition, the Validator also provides some suggestions for improvement.
  - Empirical Validity
    After the logical validity test, the researcher tested the empirical validity using the Product Moment correlation formula. Correlation results obtained a value of 0.6. The results are included in the strong category (Sugiyono, 2018). The instrument is said to be empirically valid if the value of rxy > rtable. The results of the test of the validity of the items in class XI IPA-A contained 17 valid items and 3 other items that were not valid. Meanwhile, in XI IPA-B, there are 18 valid questions and the other 2 items are invalid.
- Question reliability analysis
  Reliability testing is carried out using the Cronbach Alpha formula, namely r11 (Sugiyono, 2019). It is said to be reliable if the value of r11 0.600. However, it is not reliable if r11 0.600 (Sugiyono, 2017). Based on the calculation results for class XI IPA-A, the r11 value of 0.79 is reliable. While the results of the calculation of class XI IPA-B obtained an r11 value of 0.86 so it can be said that the instrument developed is reliable.

CONCLUSION

The conclusion from the results of this study is that the e-diagnostic test can make it easier for educators to examine learning outcomes in the form of students' cognitive abilities. Validation of questions by material experts is declared quite valid with a value of 2.66 while the validation of items from test test results is declared valid and reliable. So that the e-diagnostic test is suitable for use in the development of multi-representation-based online test questions.

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