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Development of Three-Tier Diagnostic Test Instrument Based on Multi Representation Website Assistant to Identify Digestive System Misconceptions

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Abstract

The COVID-19 pandemic has had a major impact on all aspects of human life, especially in the education aspect. Then, an online learning policy, as well as an online assessment, has been implemented as an effort to prevent the spread of the virus. Aspects of knowledge are assessed based on students' understanding of a concept obtained through teaching and learning activities. This study aims to develop a three-tier diagnostic test instrument that has been tested for feasibility, validity, and reliability. The method used in this research was Research and Development using a 4D model consisting of define, design, development, and disseminate stages. The research subjects were students of class VIII and IX of MTs Hidayatus Shibyan. The data collection was carried out using the observation method, validation sheets, test questions, and student response questionnaires. The validation sheet and classical theory analysis were used to determine the level of validity and reliability of a product. The results of material expert validation data obtained an average score of 24.8 out of 28 s and media experts obtained an average score of 20 out of 24 categorized in the very feasible criteria. The reliability analysis at the trial stage obtained 0.635 and the implementation test stage was 0.795 which indicates as reliable. The percentage of students' misconception profile on the material of the human digestive system at the trial stage was 33.6% then at the implementation test stage, the percentage was 41.7% categorized in moderate criteria. Students mostly responded very agree in the questionnaire with the percentage of 45.4% at the trial stage, and 54.2% at the implementation test stage.

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INTRODUCTION

The COVID-19 pandemic caused by the SARS-CoV-2 virus has had a major impact on all aspects of human life, especially in the education aspect. The new policy related to online teaching and learning activities is carried out as a prevention effort. There are two important things related to online learning policies, namely the implementation and impact of these policies (Aguirre & Selampinar, 2020).

Based on this, the determination of the assessment standards contained in Government Regulation no. 32 of 2013 can be done to determine the achievement and improve the quality of students (Kemendikbud, 2011).

One of the standards set out in the regulation is the assessment standard. Educational Assessment Standards are criteria regarding mechanisms, procedures, and instruments for assessing student learning outcomes (Mustopa et al., 2021).

Learning assessment tools to identify misconceptions of MTs Hidayatus Shibyan students are not yet available. the school only uses assessment tools in the form of ordinary multiple choice and essays, even though students often do not always absorb information completely, especially in subjects that contain many scientific concepts, sometimes what students understand about a scientific concept is often different from the concept adopted by experts in general (Suparno, 2013). The material for the human digestive system is found in Integrated Science subjects which are closely related to biology and chemistry subjects. The success of students in learning is also shown through their ability to solve a problem using multiple representations (Treagust et al., 2003).

The diagnostic test that will be developed in this study is a three-tier diagnostic test based on multiple representations. Based on the results of observations and interviews with science teachers at MTs Hidayatus Shibyan, it is known that even though the teacher has conveyed a concept that is appropriate to the expert, there is still a high possibility that students have misconceptions, so that this causes teaching and learning activities to be hampered.

Ahmad et al., (2020), the three-tier diagnostic test is a diagnostic test composed of three levels of questions. The first tier consists of multiple-choice questions about the concept. The second level (second-tier) consists of questions about the reasons for the answers to questions at the first level (first-tier), and the third level (third-tier) consists of questions about students' beliefs about the answers given at the first level (first-tier). and the second-tier.

The three-tier diagnostic test is able to properly diagnose students' conceptual understanding and misconceptions because this instrument is analyzed at every level (Arslan et al., 2012). Relevant research by Savira et al., (2021) related to the development of Three-Tier Multiple Choice has proven to be capable of diagnosing students' misconceptions on the buffer solution material.

According to Amarlita & Sarfan (2014), multi-representation is restating the same concept but conveying it using a different format. The conceptual understanding of students can be optimized by integrating several elements of representation in the diagnostic test instrument including definitive elements, macroscopic elements, microscopic elements, and symbolic elements. The results of the research by Asda & Andromeda (2021), showed that the application of multi-representation to the electrolyte and nonelectrolyte solution material was able to improve conceptual understanding because it was proven to be effective in improving student learning outcomes.

Wulandari (2017) explains related to the level of representation that is relevant to understanding the concept, namely: the definitive level provides information that is in accordance with the concept, the macroscopic level describes the nature of the phenomenon, the microscopic level explains what actually happens, and the symbolic level is marked by the use of symbols.

Students are said to understand the concept if students can explain or re-explain the concepts, they have learned using their own words with the same intent in a more understandable form (Sudaryono, 2014).

In this study, the implementation of the test instrument test was carried out offline with the help of the website. Website-assisted evaluation tools can be used as an alternative during a pandemic (Harefa & Sumiyati, 2020). In addition, the use of the website is very easy for teachers and students because it can be accessed anywhere and anytime. Based on this description, the researcher will develop a Three-Tier Diagnostic Test instrument based on multiple representations with the aid of a website to identify students' misconceptions.

METHOD

This research will be conducted in MTs. Hidayatus Shibyan offline in the 2021/2022 school year. The research method used is Research and Development (R&D), with a 4D design (four D) by

Thiagarajan which consists of (1) Define stage (2) Design stage (3) Development stage, and (4) Disseminate stage. The subjects in this study consisted of two classes, namely class IX and class VIII students, each of which amounted to 24. Class IX students were the test subjects, and class VIII students were the implementation test subjects. Data collection techniques were carried out by means of observation, validation sheets, test questions, and student response questionnaire sheets. Data analysis techniques to determine the feasibility of a product include a validation sheet then validity analysis using Product Moment correlation and reliability using Cronbach's Alpha. Analysis of student response questionnaire data to determine student responses to the product.

The instrument that was developed was a three-level multiple choice test based on multiple representations with the aid of a website. Students can work on questions using gadgets that are connected to the internet by accessing the link http://spm.tesdiagnostik.xyz/. The feasibility of the questions and media websites that have been previously designed are validated by material experts and media experts to determine their validity. The student's misconception profile is identified through grouping based on the level of understanding of the concept which is classified into 8 categories according to Susilaningsih et al., (2016) as shown in Table 1.

Table 1. Criteria for Student Answers and Scoring

Combination of Student Answers			Student Answer Criteria	Score
Tier 1	*Tier 2*	*Tier 3*		
True	True	Sure	Understanding Concepts (UC)	5
True	False	Sure	Negative Misconception (NM-)	2
False	True	Sure	Positive Misconceptions (PM+)	2
False	False	Sure	Full Misconception (FM)	0
True	True	Not Sure	Understand the Concept but Lack of Confidence (UCLC)	4
True	False	Not Sure	Lack of Understanding of Concepts (LUC)	3
False	True	Not Sure	Lack of Understanding of Concepts LUC)	3
False	False	Not Sure	Don't Understand the Concept (DUC)	1

After obtaining data related to the number of students who experienced misconceptions, then the percentage calculation and descriptive analysis were carried out on the material of the human digestive system.

$$\text{Per Kategori (\%)} = \frac{n}{N} \text{x } 100\%$$

Information:
n = number of students for each category
N = total number of students

RESULT AND DISCUSSION

Instrument Development

The development of the Three-Tier Diagnostic Test instrument consists of 30 questions with each question consisting of three levels. The first level is a multiple-choice question with four possible answers, the second level is the reason for the first level question, and the third level is related to students' beliefs in answering the test (Wulandari et al., 2019). The flow of the design of the Three-Tier Diagnostic Test instrument is carried out in the design and development stages in the following order (1) determining the purpose of developing test items; (2) determine the syllabus of the human digestive system; (3) create a grid of test questions; (4) preparation of questions; (5) scoring assessment; (6) expert validation; (7) research test; (8) analysis of test results data; (9) revision of questions; (10) students' misconception profiles; (11) analysis of test quality in terms of validity and reliability.

Data Analysis

Item Validity

The items of the Three-Tier Diagnostic Test instrument are said to be valid if the rxy value obtained is compared with the product moment rtable correlation price with a significant level of 5%. If $r_{count} > r_{table}$. Table 2 shows the results of the validity analysis at each stage of the test.

Table 2. The results of the validity of the items at each stage of the test

No	Research Stage	Validity Item	Item Number	Total
1	Trial Stage	Valid	1, 3, 5, 6, 7, 8, 9, 10, 11, 13, 14, 16, 17, 19, 21, 22, 23, 25, 27, 29, 30	21
		Not Valid	2, 4, 12, 15, 18, 20, 24, 26, 28	9
2	Implementation Stage	Valid	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 20	18
		Not Valid	11, 19	2

Distinguishing Power of Questions

The questions at each stage of the test have 4 types of categories, namely bad, sufficient, good, and very good. The category of discriminating power of test items shows that there are 2 very good category questions. in the good category there are 8 questions, then the sufficient category has 10 questions, and the bad category has 10 questions. The category of discriminating power of items in the implementation test phase shows that there are 4 very good category questions. in the good category there are 14 items, then the sufficient category has 1 item, and the bad category has 1 item. At each stage of the test, the most categories are sufficient and good, so that the test tool developed has the ability to distinguish between students in the upper group (students with good scores) and students in the lower group (students with low scores).

Difficulty Level

Analysis of the level of difficulty of the items means classifying the questions based on the index value of the level of difficulty of the questions or symbolized P. The index interval with the difficult category is between 0.00 – 0.30, the medium category is between 0.31 – 0.70, and the easy category is 0.70 – 1.00. The results of the analysis of the trial phase show that there are 8 items in the easy category, the easiest questions have a difficulty index coefficient (P) of 0.750. There are 20 items in the medium category. Then, there are 2 items in the difficult category, the most difficult question is item number 12 with a difficulty index coefficient (P) of 0.250. The results of the analysis of the implementation test phase show that there are 3 items in the easy category with a difficulty index coefficient (P) of 0.708. There are 13 items in the medium category and then, the questions in the difficult category have 4 items, where the most difficult item is item number 5 with a difficulty index (P) of 0.250. The questions that have the most number are in the "medium" category. This is in line with the opinion (Arikunto, 2018) The higher the difficulty index value, the easier the problem. Medium category questions are good types of questions because they can be answered by students in the upper and lower groups.

Reliability

The formula used to determine the reliability of the question as a whole uses the Alpha Cronbach formula. The reliability of the questions at each test stage shows that the reliability values obtained from the trial stage and implementation stage tend to be consistent and fall into the high reliable category because it shows r11 ≥ 0,404. The recapitulation of the reliability scores of the questions is shown in Table 3.

Table 3. Recapitulation of Question Reliability at Each Test Stage

No	Reliability Coefficient	
	Test Stage	Nilai r_{11}
1	Trial	0,635
2	Implementation	0,795

Misconception Profile Based on Basic Competency Achievement Indicators (BCI)

The profile of students' misconceptions based on indicators of achievement of basic competencies has the aim of knowing the level of students' misconceptions about a concept. Indicators of achieving basic competence (BCI) in the material of the human digestive system that students must understand include: (1) Identifying the nutritional content of food; (2) Analyze energy needs; (3) Explain the types of food nutrition; (4) Explain the nutritional function of food; (5) Identify the organs of the digestive system in humans; (6) Analyzing the process and results of mechanical and chemical digestion in humans; (7) Describe disorders and diseases related to the human digestive system; and (8) Analyzing disorders and diseases

related to the human digestive system. The profile of misconceptions based on IBC is presented in Table 4.

Table 4. Profile of Students' Misconceptions Based on Basic Competency Indicators (BCI)

Misconception Profile		
IBC	Percentage	
	Trial Stage	Implementation Stage
1	35,4	43,7
2	27,7	30,4
3	27,8	30,5
4	45,9	41,6
5	43,7	31,2
6	27,2	31,3
7	22,9	36,0
8	38,9	41,7

Based on Table 4 shows that the highest misconception profile of students in the trial stage is BCI-4 and the implementation test is found in BCI-1 of 45.9% and 43.7% while the lowest misconceptions in the trial and implementation test stages are in BCI-7 of 22.9% and BCI-3 of 30.5%. The misconception profile of each BCI is explained as follows:

(1) Identifying the nutritional content of food (BCI-1)

The first indicator at the trial stage is represented by items number 1, 2, 3, and 4 with a percentage of misconceptions of 35.4% then at the implementation test stage is represented by items number 1 and 2 with a percentage of misconceptions of 43.7%. The highest misconceptions are found in question number 4 in the trial phase as many as 12 of 24 students with a misconception percentage of 50.1% and question number 2 in the implementation test phase as many as 11 of 24 students with a misconception percentage of 45.8%.

Item number 4 of the trial phase contained in this indicator is about the fat content test contained in a sample with C4 level questions based on symbolic and macroscopic representations. Misconceptions on this question can occur because students have difficulty in distinguishing which samples contain fat. There are students who think that transparent stains on paper are due to wet food conditions while the right reason is the transparent stains that are visible when food ingredients are applied to paper due to the fat content contained in these foodstuffs (Adiyanto et al., 2021).

Item number 2 of the implementation test phase contained in this indicator is regarding the protein content test in a sample with a C4 level of questions based on symbolic and macroscopic representations. Misconceptions in this problem can occur because students experience confusion in determining the color of the sample when it is dropped by the biuret solution. There are students who think that the brick red color is the color of the sample containing protein after being dripped with biuret solution while the correct reason should be when the sample containing protein is dripped with biuret solution, the sample will be purple (Rosaini et al., 2017).

(2) Analyze energy demand (BCI-2)

The second indicator at the trial stage is represented by items number 5, 6, and 7 with a percentage of misconceptions of 27.7% then at the implementation test stage is represented by items number 3, 4, and 5 with a percentage of misconceptions of 30.4%. The highest misconceptions are found in question number 5 in the trial phase as many as 7 out of 24 students with a misconception percentage of 29.2% and in the implementation test phase as many as 10 out of 24 students with a misconception percentage of 41.6%.

Item number 5 of the trial phase contained in this indicator is asking students to analyze the Basal Metabolic Rate (BMR) with the C3 level of questions based on symbolic and microscopic representations. Misconceptions on this question can occur because students do not really understand the formula used in determining BMR.

Item number 5 of the implementation test phase contained in this indicator is asking students to analyze the fat mass that needs to be consumed with the C3 level of questions based on symbolic and microscopic representations. Misconceptions in this question can occur because students do not understand the formula for determining total calorie needs.

(3) Explain the types of food nutrition (BCI-3)

The third indicator at the trial stage is represented by items number 8, 9, and 10 with a percentage of misconceptions of 27.8% then at the implementation test stage is represented by items number 6, 7, and 8 with a percentage of misconceptions of 30.5%. The highest misconceptions are found in question number 10 in the trial stage as many as 7 of 24 students with a misconception percentage of 29.1% and question number 6 in the implementation test stage as many as 9 out of 24 students with a misconception percentage of 37.5%.

Item number 10 of the trial phase contained in this indicator is asking students to show a balanced diet with carbohydrate, fat and protein content with a C3 level of questions based on symbolic and definitive representations. Misconceptions in this matter can occur because students do not know the nutrients contained in a food. Some students only know some of the content in food ingredients.

Item number 6 of the trial phase contained in this indicator is asking students to identify food substances and their constituents correctly with the level of C2 questions based on symbolic and microscopic representations. Misconceptions on this question can occur because students feel confused in answering the question. Students do not understand what to do, so students just click on the answers.

(4) Explain the function of food nutrition (BCI-4)

The fourth indicator at the trial stage is represented by items number 11 and 12 with a percentage of misconceptions of 45.9% then at the implementation test stage is represented by item number 9 with a percentage of misconceptions of 41.6%. The highest misconceptions are found in question number 12 in the trial stage as many as 15 of 24 students with a misconception percentage of 62.5% and question number 9 in the implementation test stage as many as 10 of 24 students with a misconception percentage of 41.7%.

Question number 12 in the trial phase contained in this indicator is asking students to explain the process of forming energy from lipids and carbohydrates with the level of C2 questions based on microscopic and definitive representations. Misconceptions in this matter can occur because students still do not

understand the process of energy formation in the body.

Question number 9 of the implementation test phase contained in this indicator is asking students to identify the minerals needed for the formation of hormones with the C1 level of questions based on symbolic, microscopic and definitive representations. Misconceptions in this problem can occur because students have not been able to distinguish the uses of non-organic compounds. Many of the students did not understand each of the uses of minerals so that the answers obtained were not appropriate. Conceptually, minerals have very diverse roles in the body. One of the functions of minerals is for the formation of hormones, and iodine is one of the minerals needed for the formation of the hormone thyroxine (Wihardika, 2017).

(5) Identify the organs of the digestive system in humans (BCI-5)

The fifth indicator at the trial stage is represented by items number 13, 14, 15, and 16 with a percentage of misconceptions of 43.7% then at the implementation test stage is represented by items number 10 and 11 with a percentage of misconceptions of 31.2%. The highest misconceptions are found in question number 15 in the trial stage as many as 18 of 24 students with a misconception percentage of 75.0% and question number 10 in the implementation test stage as many as 8 of 24 students with a misconception percentage of 33.3%.

Question number 15 of the trial phase contained in this indicator is asking students to identify the digestion of Polysaccharides $(CH_2O)_n$ along the digestive tract with the level of C4 questions based on symbolic and microscopic representations. Misconceptions in this question can occur because students still do not understand the related polysaccharide digestion pathway where digestion occurs and then what enzymes are used, so that it causes students to choose the wrong answer and reason. The correct reason is that the digestion of polysaccharides or carbohydrates begins with digestion in the oral cavity. In the mouth there is saliva which contains the enzyme ptyalin to digest complex carbohydrates into simpler carbohydrates (Firani, 2017).

Question number 10 of the implementation test phase contained in this indicator is asking students to find the correct pair regarding location, enzymes, and functions with the C2 level of questions based on symbolic, microscopic, and definitive representations. Misconceptions in this question can occur because students do not memorize well the name of the enzyme, the location of the enzyme,

and the use of an enzyme so that it causes students to choose answers and reasons carelessly. The correct reason is that the enterokinase enzyme is located in the small intestine and functions to convert trypsinogen into trypsin (Surtiretna & Susanto, 2022).

(6) Analyzing the process and results of mechanical and chemical digestion in human digestion (BCI-6)

The sixth indicator at the pilot stage is represented by items number 17, 18, 19, and 20 with a percentage of misconceptions of 27.2% then at the implementation test stage is represented by items numbered 12 and 13 with a percentage of misconceptions of 31.3%. The

highest misconceptions are found in question number 20 in the trial stage as many as 13 of 24 students with a misconception percentage of 54.2% and question number 13 in the implementation test stage as many as 8 of 24 students with a misconception percentage of 33.3%.

Question number 20 in the trial phase contained in this indicator is asking students to look for the right statement regarding lipase and bile enzymes with C4 level questions based on symbolic and definitive representations. Misconceptions on this question can occur because students have not been able to relate the functions of the lipase and bile enzymes, so that it causes students to choose the wrong answers and reasons. The correct reason is that fat digestion in the small intestine is carried out by lipase enzymes and fat digestion also requires bile produced by the liver (Yunita et al., 2020). This bile functions as a fat emulsifier, which will convert fat into globules or small spheres so that they are easier to digest with the help of lipase enzymes.

Question number 13 of the implementation test phase contained in this indicator is asking students to look for the right statement about the role of the epiglottic valve with the level of C4 questions based on symbolic and definitive representations. Misconceptions on this question can occur because students experience confusion regarding the relationship between the epiglottis and the trachea and the epiglottis with the esophagus, so that it causes students to choose the wrong answers and reasons. The correct explanation is that the epiglottis is responsible for directing air into the trachea and food into the esophagus. Under normal conditions, including when we speak, the epiglottis will lift, causing the esophagus to close. Meanwhile, when we eat the epiglottis will descend so that it closes the trachea and directs food into the esophagus (Nurcahyo, 2005).

(7) Describe disorders and diseases related to the human digestive system (BCI-7)

The seventh indicator at the trial stage is represented by items number 21, 22, 23, and 24 with a misconception percentage of 22.9% then at the implementation test stage is represented by items number 14, 15, and 16 with a percentage of misconceptions of 36, 0%. The highest misconceptions are found in question number 24 in the trial phase as many as 7 out of 24 students with a misconception percentage of 29.2% and question number 16 in the implementation test phase as many as 9 out of 24 students with a misconception percentage of 37.5%.

Question number 24 in the trial phase contained in this indicator is asking students to explain precisely the consequences that occur if the gastric fluid is pushed out through the sphincter muscle, with C2 level questions based on symbolic and definitive representations. Misconceptions on this question can occur because students do not know the concept well. The correct answer is that the fluid in the stomach that is forced out through the sphincter muscle can cause irritation to the esophagus, so it feels like something is stuck in the chest. It can also cause the discharge of gastric juices and contents from the mouth, and cause stomach acid to damage the enamel layer on the teeth (Janah et al., 2021).

Question number 16 of the implementation test phase contained in this indicator is asking students to explain the use of water, salt, and sugar in making ORS to treat diarrhea. The level of question number 16 in the implementation test stage is C5 which is based on symbolic, macroscopic, microscopic, and definitive representations.

Misconceptions in question number 16 in the implementation test stage can occur because students do not know the use of the three materials, so students only answer questions that they think are correct without being adapted to the concept. The correct explanation is when a person who has diarrhea will have a condition where the intensity of bowel movements is more than usual and the feces are excreted in liquid form. This condition causes the fluid that should be absorbed to be wasted so that the body becomes dehydrated. The high intensity of bowel movements causes a person to feel tired. To overcome this, the provision of water and salt can replace the lack of water and minerals that are wasted more. Meanwhile, glucose is used to replace lost energy (Rasyid et al., 2021).

(8) Analyzing disorders and diseases related to the human digestive system (BCI-8)

The eighth indicator at the trial stage is represented by items number 25, 26, 27, 28, 29, and 30 with a misconception percentage of 38.9% then at the implementation test stage is represented by items number 17, 18, 19, and 29 with a percentage of misconceptions of 41.7%. The highest misconceptions are found in question number 26 in the trial stage, 11 of 24 students with a misconception percentage of

45.8% and question number 19 in the implementation test stage as many as 13 of 24 students with a misconception percentage of 54.2%.

Question number 26 in the trial phase contained in this indicator is asking students to analyze disorders and diseases related to the human digestive system with the C5 level of questions based on macroscopic, microscopic, and symbolic representations. Misconceptions on this question can occur because students are less able to analyze a disease in story questions, causing students to choose the wrong answer. The correct answer regarding the disorder experienced by a child specifically is the loss of the ability to produce enzymes that digest protein so that protein cannot be absorbed by the small intestine and is still found in large quantities in the feces.

Problem number 19 in the implementation test phase contained in this indicator is asking students to analyze disorders and diseases related to the human digestive system caused by consuming ice cubes from raw water with a C4 level of questions based on symbolic and definitive representations.

The misconceptions in question number 19 are the same as in the trial stage, namely because students are less able to analyze a disease in story questions, causing students to choose the wrong answer. The correct explanation regarding the correct answer is that the process of absorption of water in the body occurs in the large intestine (Surtiretna & Susanto, 2022). Water absorption takes time to run the process. Stool that is too long in the large intestine will experience more water absorption so that the stool will become harder, whereas if the stool is in the large intestine for longer than usual, the stool will become more liquid. The presence of bacteria in the digestive tract causes an increase in contractions in the large intestine, so that feces will reach the end of the large intestine faster than usual, so that the intensity of defecation will increase and feces are found in a liquid condition.

Misconception Profile Based on Concept Understanding Indicator (CUI)

The indicators used in the analysis of misconceptions are indicators of concept

understanding indicators based on the National Education Standards Agency (2007) which consist of 7 items, including (1) Restate a concept; (2) Classifying objects according to certain properties according to the concept; (3) Give examples and non examples of a concept; (4) Presenting a concept in various forms of mathematical representation; (5) Developing the necessary or sufficient conditions of a concept; (6) Using, utilizing, and selecting certain procedures; (7) Apply concepts or algorithms in solving a problem. The results of the recapitulation of the misconception profile of the achievement of concept understanding indicators at the trial stage and implementation stage can be seen in Table 5.

Table 5. Profile of Students' Misconceptions Based on Concept Understanding Indicator (CUI)

Misconception Profile		
ICU	Percentage	
	Trial Stage	Implementation Stage
1	38,4	33,3
2	31,9	35,1
3	27,1	39,6
4	18,1	27,8
5	29,2	35,4
6	43,3	41,7
7	34,5	37,5

Based on Table 5 shows that the highest misconception profile of students in the trial and implementation test stages is CUI-6 of 43.3% and 41.7% while the lowest misconceptions in the trial and implementation test stages are CUI-4 of 18.1% and 27.8%. The profile of misconceptions is explained as follows:

(1) Restate a concept (CUI-1)

The first indicator at the trial stage is represented by item number 2, 12, 18, 19, and 20 with a misconception percentage of 38.4% then in the implementation test stage is represented by item number 13 with a misconception percentage of 33.3%. The highest misconception is found in question number 12 at the trial stage, which is 15 out of 24 students (62.5%) and at the implementation stage there is question number 13, which is 8 out of 24 students (33.3%).

Question number 12 of the trial phase contained in this indicator is about the process of energy formation. Misconceptions in this problem can occur because students experience misinterpretations in distinguishing the process of energy formation from lipids from the process of forming energy from carbohydrates. Students tend to think that the process of forming energy from lipids is easier than the

process of forming energy from carbohydrates, this is contrary to the concept because the body

prefers carbohydrates as the main energy source because the process of forming energy from lipids is more complicated than the process of forming energy from carbohydrates except when the carbohydrate content in the body is too low (Surbakti, 2014).

Question number 13 of the implementation test phase contained in this indicator is regarding the use of the epiglottis. Misconceptions on this question can occur because students experience confusion in interpreting the use of the esophagus and trachea. Students think that the esophagus is related to breathing and the trachea is related to digestion, while according to the correct concept, the epiglottis is responsible for directing air into the trachea and food into the esophagus. Under normal conditions, including when we speak, the epiglottis will lift, causing the esophagus to close. Meanwhile, when we eat the epiglottis will descend so that it closes the trachea and directs food into the esophagus (Nurcahyo, 2005).

(2) Classifying objects according to certain properties according to the concept (CUI-2)

The second indicator at the trial stage is represented by items number 1, 10, 13, 14, 16, and 21 with a misconception percentage of 31.9% then in the implementation test stage is represented by items number 1, 8, 10, 11, and 14 with the percentage of misconceptions of 35.1%. The highest misconception is found in question number 13 at the trial stage and question number 1 at the implementation test stage, which is as many as 10 out of 24 students (41.7%).

Question number 13 of the trial phase contained in this indicator is regarding the upper digestive tract which is also passed by breathing. Misconceptions on this question can occur because students do not really remember the sequence of the digestive system and respiratory system. so that students cannot choose the questions correctly. students think that the answer to the question is the larynx, while according to the correct concept, the digestive tract starts from the oral cavity, pharynx, esophagus, stomach, small intestine, large intestine, to the anus (Cahyanto et al., 2021). The upper digestive tract is in contact with the respiratory tract, namely the pharynx. Although passed by food and air, food does not enter the respiratory tract because in the pharynx there is an epiglottis which is a valve to regulate the opening of the respiratory tract.

Question number 1 of the implementation test phase contained in this indicator is regarding the presence of food substances in several places of the digestive tract. Misconceptions in this question can occur because students do not understand and do not understand the concepts presented in the form of pictures. Errors in retrieving image and graphic information have a very fatal impact on determining the true meaning (Hasbullah & Nazriana, 2017). In addition, students also cannot distinguish between the uses of enzymes in each digestive organ. Conceptually, each digestive organ produces different enzymes with specific functions. In the mouth the enzyme produced is amylase or ptyalin which plays a role in breaking down carbohydrates (such as starch) into simpler sugars (such as maltose and glucose). Therefore, in the mouth has begun to occur digestion of carbohydrates so that glucose can be found. Fatty acids in the mouth are not the result of digestion of carbohydrates. The stomach produces enzymes that play a role in protein digestion, including pepsin which breaks down protein into peptone, while in the small intestine the last digestion of food substances occurs, resulting in very few complex food substances and more are found in the simplest form. Digestion in the small intestine is assisted by enzymes produced by the small intestine including maltase to break down maltose into glucose and enzymes obtained from the pancreas, namely: amylase with a similar function in the mouth, trypsin which breaks down peptone into amino acids, and lipase which together with bile to convert fats into fatty acids and glycerol (Yunita et al., 2020). Digestion that occurs in the small intestine then causes these complex nutrients to be absorbed in their simple forms including glucose, amino acids, and fatty acids.

(3) Give examples and non-examples of the concept (CUI-3)

The third indicator is to provide examples and non-examples of a concept which at the trial stage is represented by items number 8 and 11 with a percentage of misconceptions of 27.1% then at the implementation test stage is represented by questions number 6 and 9 with a percentage of misconceptions of 39, 6%. The highest misconception is found in question number 11 at the trial stage, which is 7 out of 24 students (29.1%) and at the implementation stage there is question number 9, which is 10 out of 24 students (41.7%).

The occurrence of misconceptions on this indicator because students have not been able to distinguish the uses of non-organic compounds. In this question, students are asked to look for

minerals needed for the formation of hormones. Many of the students did not understand each of the uses of minerals so that the answers obtained were not appropriate. Conceptually, minerals have very diverse roles in the body. One of the functions of minerals is for the formation of hormones, and iodine is one of the minerals needed for the formation of the hormone thyroxine (Wihardika, 2017).

(4) Presenting a concept in various forms of mathematical representation
(CUI-4)

The fourth indicator is to present a concept in various forms of mathematical representation which at the trial stage are represented by items number 9, 17, and 22 with a percentage of misconceptions of 18.1% then at the implementation test stage are represented by questions number 7, 12, and 15 with the percentage of misconceptions of 27.8%. The highest misconception is found in question number 9 at the trial stage, which is 7 out of 24 students (29.2%) and at the implementation stage it is found in question number 15, which is 8 out of 24 students (33.3%).

There was a misconception about question number 9 in the trial phase on this indicator because students did not understand and did not understand the concept of the effect of protease enzymes to break down protein on amino acid levels. Then, the misconception of question number 15 in the implementation test stage on this indicator occurs because students do not understand and do not understand dental caries. Many of the students did not understand what dental caries was and how many minutes did dental caries occur, so that the students answered incorrectly. Conceptually, dental caries is a condition of tooth loss as a result of low pH or oral acidity (Worotitjan et al., 2013). A low pH can cause disruption of deposited minerals, so that the teeth will be microscopically cavities which will eventually become large. On the graph low pH is shown at intervals of 5-25 minutes, so that it can cause dental caries.

(5) Develop necessary or sufficient requirements of a concept (CUI-5)

The fifth indicator is developing the necessary or sufficient requirements of a concept which at the trial stage is represented by items number 5 and 7 with a percentage of misconceptions of 29.2% then at the implementation test stage is represented by questions number 3 and 5 with a percentage of misconceptions of 35 ,4%. The highest misconception is found in question number 7 at the trial stage, which is 7 out of 24 students (29.2%) and at the implementation stage there is

question number 5, which is 10 out of 24 students (41.6%).

The misconceptions that occur in this indicator are caused by the lack of thoroughness of students in understanding the questions. In this indicator, the questions are presented in the form of story questions about the fat mass that the lion cubs need to consume, so that students are required to analyze the story questions carefully and carefully in the process.

(6) Using, utilizing, and selecting certain procedures (CUI-6)

The sixth indicator is using, utilizing, and choosing certain procedures which at the trial stage are represented by items number 3, 4, 15, 23, and 26 with a percentage of misconceptions of 43.3% then at the implementation test stage is represented by questions number 2 and 16 with a percentage of misconceptions of 41.7%. The highest misconception is found in question number 15 at the trial stage, which is 18 out of 24 students (75.0%) and at the implementation stage there is question number 2, which is 11 out of 24 students (45.8%).

The occurrence of misconceptions about question number 15 in the trial phase on this indicator because students have not been able to understand well the meaning and digestive system of polysaccharides. So the students' answers are not appropriate. Conceptually, digestion of polysaccharides or carbohydrates begins with digestion in the oral cavity. In the mouth there is saliva which contains the enzyme ptyalin to digest complex carbohydrates into simpler carbohydrates (Firani, 2017). In the stomach, carbohydrates do not undergo digestion, so further digestion occurs in the duodenum or duodenum. In the duodenum there is amylase produced by the pancreas to continue the breakdown of short polysaccharides into disaccharides. The duodenum also produces enzymes to break down disaccharides.

There was a misconception about question number 2 in the implementation test phase for this indicator, namely the identification of foods that contain protein. The students' misconceptions on this question are because students do not understand well the protein test

indicators, causing students to choose the wrong answer.

(7) Applying concepts or algorithms in problem solving (CUI-7)

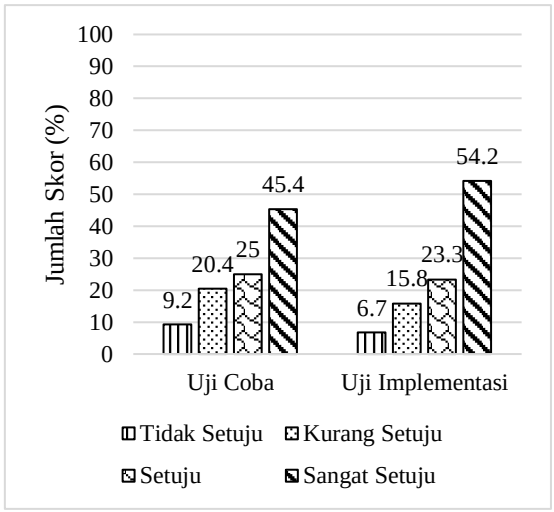
The seventh indicator is applying concepts or algorithms in problem solving which at the trial stage are represented by items number 6, 24, 25, 27, 28, 29, and 30 with a misconception percentage of 34.5% then at the implementation test stage is represented by questions numbers

4, 17, 18, 19, and 20 with a misconception percentage of 37.5%. The highest misconception is found in question number 29 at the trial stage, which is as many as 10 out of 24 students (41.7%) and at the implementation stage it is found in question number 19, which is 13 out of 24 students (54.2%).

The questions contained in this indicator are about poisoning which is characterized by abdominal pain and liquid defecation and continuous intensity caused by buying a drink where the ice cubes used are raw water. The occurrence of misconceptions on this indicator is because students experience doubts in explaining the material contained in this question, thus making students experience errors in explaining the material, so students answer inappropriately. Conceptually, the process of water absorption in the body occurs in the large intestine. Water absorption takes time to run the process. Stool that is too long in the large intestine will experience more water absorption so that the stool will become harder (Kusniawati, 2021). Meanwhile, if the stool is in the large intestine for longer than usual, the stool will become more liquid. The presence of bacteria in the digestive tract causes increased contraction of the large intestine, so that feces will reach the end of the large intestine faster than usual. So that the intensity of defecation will increase and feces are found in a liquid condition.

Student Response Questionnaire

Student response questionnaires to the three-tier diagnostic test instrument distributed in the implementation test were made in the form of a Google Form. The response questionnaire consists of 10 statement items. Students were asked to choose the option strongly agree, agree, disagree, and disagree. The results of the student response questionnaire analysis are presented in Picture 1



Picture 1. Results of Student Response Questionnaire Analysis

The results of the analysis of 24 student response questionnaires at the trial stage stated that 45.4% of students strongly agreed, 25.0% of students agreed, then 20.4% of students said they did not agree, and 9.2% of students did not. agree. Then, the analysis of 24 student response questionnaires for the implementation test stated that 54.2% of students strongly agreed, 23.3% of students agreed, then 15.8% did not agree, and 6.7% of students disagreed about instrument three. - Tier diagnostic test developed. The results of the questionnaire stated that the most students' responses to the three-tier diagnostic test instrument were strongly agree and agree. It can be concluded that students feel interested in the application of the developed three-tier diagnostic test instrument.

CONCLUSION

The website-assisted Three-Tier Diagnostic Test instrument that was developed succeeded in identifying students' misconceptions on the material of the human digestive system. Analysis of the reliability of the instrument at the trial stage of 0.635 and the implementation test stage of 0.795. Then the profile of students' misconceptions on the material of the human digestive system at the trial stage and implementation test stage obtained a percentage of 33.6% and 41.7% which can be categorized in medium criteria. In addition, the results of the analysis of student responses to the website-assisted Three-Tier Diagnostic Test instrument gave a very agree response, namely 45.4% at the trial stage, and 54.2% at the implementation test stage.

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