Evaluation of Concept Mastery and Representation Skills Assessment in High School on Nervous System Material

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Article Information	ABSTRACT
	Learning demands that students not only memorize facts but also understand concepts in depth to be able to accurately represent scientific phenomena. This research aims to produce a valid assessment of concept mastery and representation skills. This research used descriptive quantitative method with a total of 60 Grade XI students who had received nervous system material. The validity instrument test of concept mastery and representation skills were analyzed based on logical validity and empirical validity. The results of the logical validity of concept mastery questions by expert validator lecturer of 92.69% and biology teacher of 100% indicate that this instrument is highly valid to measure student understanding of nervous system material. The results of the logical validity of the representation skills question by expert validator lecturer of 73.10% and biology teacher of 100% indicate that the test instrument is valid to measure students' representation skills, but moderate revisions are needed. On the other hand, results of empirical validity show that multiple choice questions have a validity of 0.56 and reliability of 0.72, while essay questions have a validity of 0.46 and reliability of 0.63. Thus, the instruments test of concept mastery and representation skills of nervous system material fall into the moderately valid to highly valid category.
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INTRODUCTION

Education is an important factor in nation building, focusing on improving the quality of human resources through effective learning (Sukmayadi & Yahya, 2020; Husna et al., 2023). In the domain of science, learning requires students not only to memorize facts but also to understand concepts deeply (D'Alessio et al., 2019; Dring, 2019; Sidiq et al., 2021). In depth concept

understanding includes factual, conceptual, and procedural understanding displayed in various modes of representation (Krathwohl, 2002; Orina et al., 2022; Cindiati., 2021). Representation skills in biology learning are one of the important aspects that help students understand concepts deeply through various forms, such as diagrams, tables, graphs, and causal reasoning (Edelsbrunner et al., 2023; Fatmawati et al., 2024; Kim & Park, 2024; Bizimana et al., 2022).

Facts in the field show that learning in schools has not empowered students' ability to represent a concept (Harmain, 2021; Natalia et al., 2023). Students have difficulty in understanding various biological concepts that are abstract, complex, and interrelated with each other, one of which is nervous system material. Nervous system knowledge is part of the concept of neuroscience and the relevance of nervous system knowledge in society (Kvello & Gericke, 2021). Based on the results of the preliminary study analysis of class XI at SMAN 5 Bandung using essay questions on nervous system material according to the three aspects of representation skills, namely conceptual, reasoning, and mode, the average score was 51.

The results of preliminary study analysis on conceptual aspects show that 40% of students apply context from one domain to another knowledge domain by explaining the relationship between the two domains to scientific phenomena. Concept mastery is marked by the ability to integrate knowledge in the thinking process and daily life (Kadarusman et al., 2020; Bosch et al., 2021). The reasoning aspect shows that 68% are able to explain concepts deductively from one form of representation. The results of Luzyawati et al. (2020) stated that students' scientific reasoning ability in essay tests was in the moderate category. Furthermore, mode aspect shows that 34% of students are able to convert information into visual representations such as tables. The findings of Akbar & Delvira (2022) stated that students' skills in creating tables and graphs in biology learning were moderate.

Previous research shows that students who are not trained in representation skills have difficulty in identifying and analyzing various forms of representation (Natalia et al., 2023; Utami & Subiantoro, 2020; Fenwick & Unsworth, 2022). Understanding of scientific concepts is formed from the interaction between internal and external representations, where external representations assist the cognitive process in understanding abstract concepts (Munfaridah et al., 2021; Natalia et al., 2023). According to this, multiple representations provide flexibility for teachers to adapt materials to student learning needs so that concept understanding is more optimal (Diani et al., 2024).

Related research emphasizes that multiple representations in science learning promote students' conceptual understanding, representation skills, and learning motivation (Bologna et al., 2022; Alsalhi, 2020; Zhou et al., 2017). Multiple representations allow students to represent the same concept through various forms, such as visual (diagrams, graphs, tables) and figurative (analogies and metaphors) (Adelia et al., 2023). Utilization of various representations is important in learning biology because it adapts learning to diverse learning styles (Diani et al., 2024; Cheng & Gilbert, 2015; Ke et al., 2021; Lestari et al., 2023; Syahri et al., 2021). Visual representations, such as graphs and diagrams, as well as causal reasoning, help students discover the relevance of biology to everyday life (Altindis et al., 2024). Thus, encouraging active engagement in learning that results in increased competence and learning satisfaction (Alsalhi, 2020).

Assessment evaluation in biology learning, especially on nervous system material, needs to be adjusted to competency achievements due to the complex and abstract nature of the material (Rachmaningsih & Purnomo, 2024). Objective concept mastery assessment can be done through multiple choice questions (Edelsbrunner et al., 2023). Meanwhile, representation skills are evaluated through open-ended test questions that allow students to show analysis and processing of information (Zubaidah et al., 2018; Nedjat-Haiem & Cooke, 2021). The essay test application provides space for students to express written and visual representations in more depth (Fenwick & Unsworth, 2022).

Based on empirical data and facts in the field, biology teachers in schools do not develop their own biology assessments but only adjust the items to the material being taught. Teachers also rarely use essay questions, so that students' skills in representing concept understanding are less honed. Therefore, an instrument in the form of a written test is needed as an effort to improve concept mastery in facilitating students' representation skills on nervous system material. This article will conduct research entitled "Evaluation of Concept Mastery and Representation Skills Assessment in High School on Nervous System Material".

RESEARCH METHODS

This research uses descriptive quantitative research methods with a cross-sectional design (Sugiyono, 2022). The main reason researchers use cross-sectional descriptive quantitative methods is because researchers want to describe a phenomenon, without making changes, and test cause and effect with one-time data collection. For this case, the researcher only focuses on the

validity and reliability of the written test instrument for concept mastery and representation skills of human nervous system material based on empirical data at one time.

The population in this research were all students in grade XI of SMA Negeri 78 Jakarta in the 2024/2025 academic year who had learned the material of the nervous system. The sample consists of 60 students from classes XI-C and XI-D, selected using convenience sampling based on the recommendation of the biology teacher at the school. The selection of these two classes was based on their academic performance in the moderate to high categories. Class XI-E was not included in the study due to its low academic performance, which could potentially affect the accuracy of the empirical validity of the test instrument.

Even though the sample size is relatively small for a cross-sectional research design, a sample size of 60 students is considered adequate. This is in line with the principle of construct validity and minimum sample size guidelines for medium effect detection as described by Cohen (1988) that exploratory research with a focus on item stability and validity can use small samples, as long as the sample characteristics are sufficiently representative of the target population.

The selection of the research location at SMA Negeri 78 Jakarta, different from the preliminary study analysis location, was motivated by the conditions in the field. This is because most of the eleventh-grade students in Bandung have not learned the nervous system material and the XII grade cannot be involved because they have completed the final exam. The consideration was made to avoid delays in research activities in the development of test instruments, so that they could be carried out in a timely manner and relevant to the research objectives.

The instruments used in this research are written test instruments in the form of multiple choices questions and essay questions. Multiple choice questions amounted to 18 items to measure mastery of concepts adapted to the number of learning objectives of the cognitive dimension. Essay questions amounted to 14 items representing 7 indicators of representation skills adapted from Schönborn & Anderson (2009). The measurement framework of the dependent variable can be seen in Table 1.

Table 1. The measurement framework of the dependent variable

Variable	Measurement Aspects	Form of Test Instrumen	Number of Items
Concept Mastery	Learning Objectives: 1. Analyze the structure and function of the constituents of the nervous system in a phenomenon about the mechanism of nerve	Multiple Choice	3 items

Variable	Measurement Aspects	Form of Test Instrumen	Number of Items
	impulses that occur in the human body through visual representation (picture or table).		
	2. Analyze the nervous system in visceral organs through visual representation of a phenomenon.	Multiple Choice	3 items
	3. Analyze the response of the nervous system to internal and external stimulus in the human body through visual representation (schematic of nervous system pathways) of a phenomenon.	Multiple Choice	3 items
	4. Analyze cases of disorders involving neuronal activity associated with the structure and function of neuron in the human body through visual representation (table).	Multiple Choice	3 items
	5. Analyze the changes in visual representation of a concept of disorders and disorders of the nervous system that occur in society.	Multiple Choice	3 items
	6. Analyze cases of impaired function of the constituents of the nervous system to solve problems through the application of new external representation.	Multiple Choice	3 items
Representation Skills	Indicators: 1. Conceptual	Essay	2 items
	2. Conceptual-Mode	Essay	2 items
	3. Reasoning	Essay	2 items
	4. Reasoning-Conceptual	Essay	2 items
	5. Reasoning-Mode	Essay	2 items
	6. Mode	Essay	2 items
	7. Conceptual-Reasoning-Mode	Essay	2 items
Total			**32 items**

The research procedure carried out consists of two phases, namely the preparation phase and the implementation phase. The preparation phase includes creating test questions, revising the results of guidance based on comments and suggestions from the supervising lecturer, revising the results of logical validity based on the assessment of biology education lecturers and high school biology teachers, and obtaining permission to conduct the research. The implementation was conducted offline over two days, on Monday April 21 and Wednesday April 23, aligned with the school's biology class schedule of 90 minutes. The implementation is adjusted to the biology learning hours at SMA Negeri 78 Jakarta even semester of the 2024/2025 school year, which is approximately 90 minutes. The test was divided into two sets of questions, set A assessing

conceptual understanding for 45 minutes and set B assessing representation skills for 45 minutes. The following is a description of each phase of the research.

Preparation Phase

The prepartion phase described in more detail in this study includes the logical validity phase of the instrument. Logical validity aspect testing was conducted by two validators, namely university lecturers as biology education practitioners and high school biology teachers. Although the two validators focused on different perspectives, biology education practitioners focused on the accuracy of the nervous system concept, the suitability of the questions with the learning objectives, and the indicators of representation skills. Meanwhile, the high school biology teacher focused on the clarity of the question wording, the level of difficulty, and the usefulness of the questions. Nevertheless, both validators comprehensively assessed the three main aspects of logical validity, which are content validity, construct validity, and language aspect.

Content validity aspect includes the overall subject matter, which covers the assessment of the suitability of stimuli in each question, whether the items support the achievement of learning objectives and skills indicators comprehensively, whether the questions are able to measure conceptual understanding and representation skills, and whether the level of difficulty of the questions is appropriate for the cognitive abilities of high school students in phase F.

The construct validity aspect assessed by expert judgment includes the arrangement of items that covers the suitability between the questions in each item and the learning objectives and representation skills indicators, the clarity of the stimulus, the logicality of the answer options, and the suitability of the answer keys with the questions. The research by Jin-Hee & Jeung-Im (2021) indicates that expert assessment is still recognized as part of the validation process. Expert judgment on the structure of the items can be used as preliminary evidence of construct validity logically, before conducting statistical tests using Confirmatory Factor Analysis (CFA) to determine whether the indicators within the variable remain consistent within that variable or not.

Language aspect evaluated to ensure clarity, avoidance of ambiguity, and alignment with the General Guidelines for Indonesian Spelling (PUEBI), without requiring readability tests. This procedure aligns with Hidayati et al. (2023), who affirm that expert assessment of sentence structure and stimuli contributes to logically valid content and construct validation in instrument development. Logical validity is calculated using the formula listed below. The analysis of logical validity criteria refers to Akbar (2013), which can be seen in Table 2.

$$\text{Percentage score of validation results (\%)} = \frac{\text{acquisition score}}{\text{maximum score}} \times 100$$

Table 2. Criteria Logical Validity

Percentage (%)	Criteria	Description
81-100	Highly valid	Can be used without revision
61-80	Valid	Minor revision
41-60	Less valid	Major revision
25-40	Not valid	Not allowed to use

Akbar (2013)

Implementation Phase

In the implementation of the written test, which consisted of multiple choice and essay questions, researchers minimized potential bias by ensuring that all students completed the test individually under the direct supervised of biology teachers and researchers in the classroom. In addition, students received clear instructions before test, include guidance to complete either odd nor even numbered essay questions. Clear instructions help ensure that students' answers reflect their personal understanding, rather than the result of group discussions or online searches (Rawe et al., 2025). These control measures aim to maintain the internal validity of the data collected.

The results of written tests taken by 60 students in two classes were used to test the empirical validity of the two test instruments that had been developed. Empirical validity was used to test the written test instruments for mastery of concepts and representation skills in students who had studied the nervous system. Empirical validity was tested using the Pearson product moment correlation that looking at the rXY value or seeing the correlationXY value in the Anates calculation results. Empirical validity analysis uses the help of Anates Version 4.05 software. Correlation values can be analyzed using the test validity criteria based on Arikunto (2013), as shown in Table 3.

Table 3. Criteria Empirical Validity of Questions

Validity Score	Criteria
0.80-1.00	Very high
0.60-0.80	High
0.40-0.60	Moderate
0.20-0.40	Low
0-0.20	Verylow

Arikunto (2013)

RESEARCH RESULT

Logical Validity of Concept Mastery Questions

The logical validity of concept mastery questions was tested by two validators, namely biology education practitioners and high school biology teachers. The results of the logical validity of concept mastery questions in the form of 18 multiple choice questions can be seen in Table 4.

Table 4. Results of All Item Logical Validity of Concept Mastery Questions

Assessed Aspects	Total Expert Validator Score	Total Biology Teacher Score
Content Aspect		
Stimulus in the form of information, illustration schemes, tables, graphs, or text on each item directs students to analyze.	72	72
Stimulus in the form of information, illustration schemes, tables, graphs, or text on each item used to provide context to the question supports the achievement of the 6 learning objectives of nervous system material with the help of various representations integrated with the learning cycle 5E.	54	72
The questions are able to measure the level of understanding of students' knowledge related to nervous system material.	72	72
The questions have a level of difficulty that is in accordance with the cognitive abilities of high school students in phase F.	72	72
The information, tables, graphs, or text used in each question item are continuous with the question given.	71	72
Question Item Arrangement Aspect		
Illustration schemes, tables, graphs, or text are presented clearly.	54	72
The questions are clearly formulated.	54	72
The questions are not easy to guess.	72	72
The answer options on each item are logically organized.	72	72
The answer key is according to the question asked.	72	72
The answer key does not show a specific pattern of answers so that it is easy for students to guess.	72	72
Possible problems to solve.	70	72
Language Aspect		
The editorial on each question item uses good and correct Indonesian, communicative, and clear so that it does not cause double interpretation.	54	72
The editorial of each question item uses writing, spelling, and punctuation in accordance with the General Guidelines for Indonesian Spelling (PUEBI).	72	72
The stimulus used in each question item uses terms that can be understood by students.	68	72
Acquisition Score	1001	1080
Maximum Score	1080	1080
%=(Acquisition Score / Maximum Score)×100	**92.69**	**100**
Criterion	**Highly Valid**	**Highly Valid**

Table 4 provides an overview of the overall logical validity of the test items for concept mastery by both validators, which falls under the "Highly valid" criterion. However, since the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) value obtained was $0.466 < 0.50$, confirmatory factor analysis could not be performed. Therefore, construct validity was strengthened through expert assessment of the test item structure, including the alignment of questions with learning objectives to measure concept mastery and representation skill indicators. The logical validity results for the test item structure aspect in the logical validity assessment by both validators indicate that all test items for concept mastery meet the "Highly Valid" criteria.

The improvement of 18 items of concept mastery questions is adjusted to the validator's comments and suggestions. The summary of the improvements based on the validators' comments and suggestions are presented in Table 5. The results of the logical validity from two validators are presented in Table 1. Validation was conducted between April 24 and May 2, 2025.

Table 5. Summary of Expert Validators' Comments & Suggestions on Concept Mastery Items

Number of Items	Questions	Comments and Suggestions	Improvements
1.		• One form of visual representation (picture, tabel, and diagram) is only used for one item.	
4.		• It is necessary to re-read concept mastery question number 4 related to the concept of sympathetic and parasympathetic.	
7.			
11.		• It is recommended to improve sentence redaction in concept mastery questions or representation skills questions that show Picture and Table.	
14.			
18.			

Table 5 shows a summary of the improvement of concept mastery questions according to the comments and suggestions of expert validators that are tailored to the needs. The improvements made are included in the minor scale because they improve the editorial stimulus of the question without changing the overall question items. This is in line with the results of the logical validity of concept mastery questions in the aspects of content, construct, and language validity Table 4 which shows that the stimulus in 18 items directs students to analyze so that the questions are not likely to be easily guessed because they have certain answer patterns.

Logical Validity of Representation Skills Questions

The logical validity of representation skills questions was tested by two validators, namely biology education practitioners and high school biology teachers. The logical validity results of representation skills questions in the form of 14 essay questions can be seen in Table 6.

Table 6. Results Logical Validity of Representation Skills Questions

Assessed Aspects	Total Expert Validator Score	Total Biology Teacher Score
Content Aspect		
Stimulus in the form of information, illustrative schemes, tables, graphs, or text on each question item directs students to analyze.	42	56
Stimulus in the form of information, illustrative schemes, tables, graphs, or text on each question item is used to provide context to the question to support the achievement of the representation skills indicators used.	42	56
The question was able to measure the level of students' representation skills represented by three aspects, namely conceptual, reasoning, and mode (making or changing the shape of a visual representation) which were formulated into 7 indicators of representation skills used.	42	56
The questions have a level of difficulty that is in accordance with the cognitive abilities of high school students in phase F.	42	56
The information, tables, graphs, or text used in each question item are continuous with the question given.	42	56
Question Item Arrangement Aspect		
Questions are in accordance with representation skills indicators.	42	56
Questions supporting indicators of representation skills.	40	56
Illustration schemes, tables, graphs, or text are presented clearly.	32	56
The questions are clearly formulated.	42	56
The answer key is according to the question asked.	42	56
The answer key assessment rubric is in accordance with the learning objectives that support representation skills.	38	56
Possible problems to solve.	42	56
Language Aspect		
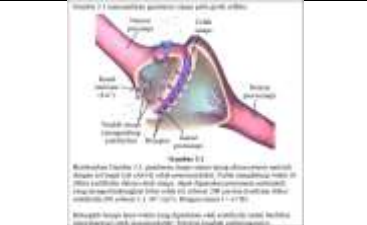
Assessed Aspects	Total Expert Validator Score	Total Biology Teacher Score
The editorial on each question item uses good and correct Indonesian, communicative, and clear so that it does not cause double interpretation.	42	56
The editorial of each question item uses writing, spelling, and punctuation in accordance with the General Guidelines for Indonesian Spelling (PUEBI).	42	56
The stimulus used in each question item uses terms that can be understood by students.	42	56
Acquisition Score	614	840
Maximum Score	840	840
%=(Acquisition Score / Maximum Score)×100	**73.10**	**100**
Criterion	**Valid**	**Highly Valid**

Table 6 shows that the logical validity of the test instrument for essay questions on the representation of nervous system material by both validators is included in the "Highly valid" criteria. Meanwhile, confirmatory factor analysis could not be continued in this study due to an inadequate sample size. According to Kyriazos (2018), CFA is a method that requires a large sample size to produce stable parameter estimates and a valid model fit. In this study, dividing the essay questions into odd-numbered questions (31 students) and even-numbered questions (29 students) resulted in a limited number of responses per indicator, thus failing to meet the CFA eligibility criteria.

As a follows up, 14 questions on representation skills were revised based on comments and suggestions from expert validators. The summary of these revisions is presented in Table 7 and organized based on the seven representation skills indicators used as aspects of representation skill measurement in Table 1. The indicators of representation skills are derived from the three aspects of representation skills proposed by Schönborn & Anderson in 2009, namely, 1) conceptual elements represent students' conceptual knowledge of relevance to a variety of representations; 2) reasoning elements represent all reasoning abilities needed to interpret a variety of representations; and 3) representation mode elements characterize the external nature of the representation, including symbolic signs (Anderson et al., 2013).

Thus, the logical validation process and revision of the written representation skills test instrument not only strengthen the construct aspect. In addition, logical validity also contributes to ensuring the conceptual and visual representation of representation skills indicators.

Table 7. Summary Comments and Suggestions of Expert Validators on Representation Skills

Number of Items	Questions	Comments and Suggestions	Improvements
1.		• Using scoring from the answer key because the criterion rubric is more suitable for questions that have uncertain answers.	
2.		• Adjusting the answer key by determining at least 1 or 2 keywords to be made as scoring.	
3.		• Improving the image on the stimulus of the conceptual indicator essay question. • Improving the image on the stimulus of the reasoning indicator essay question.	
4.		• Correcting the table data on the stimulus of the conceptual-reasoning indicator essay question.	
5.		• Adding an essay question that asks students to analyze the concept of nerve from the picture.	
6.			
7.			

Empirical Validity of Concept Mastery and Representation Skills Questions

Table 8. Anates Calculation Results Empirical Validity of Concept Mastery and Representation Skills Questions

Variable	Number of Students	Validity	Realiability
Concept Mastery	60	0.56	0.72
Representation Skills	60	0.46	0.63

Based on Table 8, it can be interpreted that the written test of concept mastery in the form of multiple choice questions totaling 18 items can be used entirely in classroom implementation. This is because the validity of the question seen from the rXY correlation value in the Anates calculation is 0.56 with the category "Moderate" and the reliability value of the question is 0.72 with the category "High". This is in line with the results of the analysis of the empirical validity criteria of the questions based on Arikunto (2013) in Table 3 which shows that the validity score above 40 is included in the "Moderate" criteria. Thus the written test that has been prepared is "Moderate" to measure students' mastery of concepts on nervous system material. Revisions are needed on several items that have negative significance values. Improvements to 12 items that have a negative significance value focus on improving the question exemption and stimulus without changing the entire question.

A written test to measure representation skills in the form of essay questions totaling 14 items will be selected 7 items according to the number of representation skills indicators. The rXY correlation value in the Anates calculation of 0.46 has a "Moderate" category and the reliability value of the question is 0.63 "High" category. The written test that has been prepared is valid enough to measure 7 indicators of representation skills on nervous system material. However, because 7 significant items only represent 4 indicators of representation skills including conceptual, conceptual-mode, reasoning, and mode. Therefore, the determination of the 7 selected items is based on the level of difficulty, differentiating power, T value which describes the average student score per item, and correlation value. The question items that will be used in the implementation after testing this question are number 2, 3, 5, 8, 10, 11, and 14. The improvement of 7 question items focuses on improving the stimulus and redaction of question sentences that are adjusted to the aspects of representation skills, namely conceptual, reasoning, and mode (visual representation form).

DISCUSSION

Logical Validity of Concept Mastery Questions

The instrument of concept mastery questions developed in this research showed a logical validity level of "Highly valid" with a percentage of 92.69% by biology education practitioners and high school biology teachers by 100%. This percentage indicates that the instruments have met the aspects of content, item arrangement, and language to measure students' concept mastery of the nervous system material properly and thoroughly. This finding was strengthened by the comments and suggestions from the validators presented in Table 5. The revision of the instrument items was carried out based on this input, as material from efforts to strengthen the arrangement of items which is an aspect of construct validity from the logical validity of the concept mastery test instrument.

The previous research in science showed that visual representation-based approach can improve students' concept understanding and scientific consistency (Pramonoadi et al., 2020). This is in line with the results of the research, that stimuli in the form of illustrative schemes, tables, and graphs play a role in improving students' analysis of the concept of the nervous system. Integration of visual representations with written questions contributes to improving the quality of conceptual assessment (Fatmawati et al., 2024; Edelsbrunner et al., 2023; Diani et al., 2024).

Logical Validity of Representation Skills Questions

The logical validity results of concept mastery questions by expert validator lecturers of 73.10% and biology teachers of 100% show that this instrument is "Valid" to measure students' representation skills, but moderate revisions are needed. From the data, it can be seen that the instrument has fulfilled the aspects of content, item arrangement, and language to measure students' representation skills of the nervous system material. This finding is reinforced by comments and suggestions from validators which can be seen in Table 7.

Research by Lengkana et al. (2019) on the effect of mind mapping on representation skills showed that the use of visual representations in learning can improve students' understanding of scientific concepts. The representation skills questions tested include conceptual, reasoning, and mode aspects (Schönborn & Anderson, 2009; Anderson et al., 2013). Thus, the external representation in the questions can help students in understanding the nervous system material more deeply.

Empirical Validity of Concept Mastery and Representation Skills Questions

The empirical validity shows that multiple choice questions have a validity of 0.56 and a reliability of 0.72, while essay questions have a validity of 0.46 and a reliability of 0.63. This finding illustrates that the concept mastery and representation skills test questions are "Moderate" and "High". Thus, it indicates that the written test instrument developed has a quality that is suitable for use in evaluating learning of the nervous system in high school.

This finding is consistent with previous research that the systematic use of visual representations in assessments can increase the validity of the instrument and encourage students' understanding of nervous system material which is one of the complex and abstract biological concepts (Tresnaningsih et al., 2019; Promonoadi et al., 2020; Fatmawati et al., 2024). In this research, revisions were made to 12 multiple choice questions and 7 essay questions, focusing on improving the stimulus and sentence wording to be more in line with the representation skills indicators.

CONCLUSION

The results of the research analyzing the validity of the concept mastery test instrument and the representation skills of High School biology material on the human nervous system based on logical validity and empirical validity showed that the instrument test of concept mastery and representation skills of the nervous system material fall into the category of quite valid to highly valid. Thus the test instrument in the form of multiple choices questions and essay questions can be used to measure students' concept mastery and representation skills on nervous system material.

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