

Integrated Assessment Instruments of Critical Thinking Skill and Creative Thinking Skill on Biology Course: An Innovative Assessment for 21st Century Skills

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Abstract: *The scarcity of an integrated assessment instrument for critical thinking abilities, creative thinking skills, and legitimate cognitive learning outcomes, which contributes to the inaccuracy of assessments of 21st century learning skills competencies. This study intends to verify the product produced in the form of an integrated assessment instrument for critical thinking abilities, creative thinking skills, and cognitive biology learning outcomes up to the validation stage. A 4-D model is used in this research and development (R & D). The integrated assessment instrument's product validity test is based on the evaluations of two professional validator lectures. The validation stage data collecting approach is employed, specifically the validity test, which is measured using an assessment instrument validation instrument created by the researcher and sent to expert validators to validate the integrated assessment instrument product. The results revealed that the integrated evaluation instrument's product quality, with an average score of (4.41), was in the valid category. The product is valid in the form of an integrated assessment tool for critical thinking abilities, creative thinking skills, and cognitive biology learning objectives.*

Keywords: Integrated assessment instruments, Critical thinking skills, Creative thinking skills, 21st century learning

1. Introduction

The current age is distinguished by fast developments in numerous sectors of life, particularly the employment of artificial intelligence [1]. Science and technology are rapidly evolving in the twenty-first century, and knowledge is easily transmitted to all corners of the country and throughout the world. As a result of the advancement of globalization, we are confronted not only with a difficulty, but also with opportunity. This indicates that in this global period, there is a chance to enhance the Indonesian people's and nation's living conditions. To face the difficulties and global rivalry of the twenty-first century, it is critical to develop high-quality human resources [2].

Improving human resources is inextricably linked to formal education. Education is a basic human necessity since it plays a significant part in the success of nation building in order to achieve general welfare and educate the country's life as the nation's values [3], [4], [5]. In the era of 21st century knowledge, high quality human resources are needed who have skills such as being able to work with others, think critically, creatively, skilled, understand various cultures, communication skills, computer skills, and self-regulated learning [6]. The completion of 21st Century abilities is the first step in realizing the nation's goals in education.

Higher order thinking skills are an indicator of the effectiveness of strengthening human resources in the field of education in the twenty-first century [7], [8]. Critical thinking and creative thinking are 21st century talents [9], [10]. Students need a learning process that is able to activate them in learn-

ing both physically and mentally. Learning will be more meaningful if a learning process is applied that can train thinking skills such as critical and creative thinking and collaborate in creating a warmer social system during the learning process. In addition, the applicative abilities of students obtained from the learning process can be applied in real life, it is also important to present [11]. This is consistent with Permendikbud No. 20 of 2016, which states that high school graduates must have creative, productive, critical, autonomous, collaborative, and communicative thinking and acting abilities gained in school [12]. Every learning environment in a school must foster the development of critical thinking abilities.

In today's educational landscape, instructors are tasked with developing and implementing curriculum as well as assessing its success [13], [14]. The evaluation outcomes are one measure of effectiveness in meeting learning objectives [15], [16]. This is because evaluating learning outcomes is the closest thing to the aims of education in general [17].

The process of evaluating learning outcomes necessitates the use of an assessment instrument, which is a tool used to facilitate the evaluation process. A written test is one of the instruments or tools that may be utilized [18]. Suitable evaluation instruments should also be utilized to achieve appropriate assessment findings. Furthermore, the instrument, as an assessment tool, plays a significant part in assessing the effectiveness of the learning process. The findings of a good and suitable assessment reflect or demonstrate that the instruments used to assess are also appropriate and fulfill the learning requirements.

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Learning must develop students' thinking abilities, particularly higher-order thinking skills, which must be integrated into school-based learning, including biology [19]. The production of HOTS questions in Biology courses is still relatively unusual, despite the fact that, given the features of HOTS questions, it is critical to enhance students' thinking abilities, particularly in studying biology, in order to meet the Graduate Competency Standards [20]. This event is still a major issue in many schools. In reality, despite the fact that critical thinking abilities are crucial for global education, efforts are being made to quantify critical thinking skills [21], [22]. Finally, the instructor is unable to measure students' abilities holistically using written examinations and unvalidated tests [23]. Based on the preceding reasoning, it is critical to develop innovative evaluations that teach 21st century abilities, particularly biology learning.

2. Method

This research is referred to as R&D. Research and development is a set of methods used to create a new product or enhance current ones so that they can be tracked. The research was conducted from August to September 2022. The focus of this assessment is an integrated assessment instrument for assessing 21st century abilities in biology learning, particularly critical thinking skills Ennis, (1980), creative thinking skills Munandar, (2009), and cognitive biology learning outcomes (Bloom revision). Biology study material for class XI SMA/MA basic competency 3.12 uses a 4-D (Four D) study strategy to examine the effect of the immune system and vaccination on physiological processes in the body, although it has only entered the development stage owing to time and circumstance restrictions.

The tools utilized in this study were (1) research instrument validation sheets and (2) assessment instrument product validation sheets. The assessment instrument's product development is divided into three major stages: definition, design, and development. The validity examination by validator lecturers of education specialists is the data analysis approach employed. The product validity test is graded on four criteria: content validity, construct, language or culture, and design.

3. Results

The initial results of data analysis from the instrument validity test assessed by the expert validator lecturers can be seen in the table 1.

Table 1: Analysis of Instrument Validity Data Results by Expert Validator Lecturers

No.	Aspect of Evaluation	Validator Evaluation		Average	Information
		Validator I	Validator II		
1	Validity of the content	4.14	4.57	4.36	Valid
2	Construct	4.2	4.8	4.5	Valid
3	Language or culture	4	4.6	4.3	Valid
4	Design	4.25	4.75	4.5	Valid
Overall Average				4.41	Valid

According to table 1, the results of the assessment of the two expert validator lecturers on the product of the integrated assessment instrument for critical thinking skills, creative thinking skills, and cognitive biology learning outcomes indicate that this research product is in the valid category. Then proceed limited trial of assessment instruments to measure the empirical validity in table 2

Table 2: Empirical Validity

Question Number	R table	R hitung	Criteria
1	0.4	0.861	Valid
2	0.4	0.831	Valid
3	0.4	0.790	Valid
4	0.4	0.622	Valid
5	0.4	0.744	Valid
6	0.4	0.601	Valid
7	0.4	0.808	Valid
8	0.4	0.861	Valid
9	0.4	0.870	Valid
10	0.4	0.774	Valid

Table 2 showed a limited trial to measure empirical validity using the Pearson product moment correlation equation using the Microsoft Excel application, it is known that all items are valid. Result Reliability assessment instrument data is shown at table 3

Table 3: Reliability

Question Number	Item Variance	Total variance	Reliability
1	1.050	41.067	0.686
2	0.667		
3	0.650		
4	0.783		
5	0.829		
6	1.629		
7	1.929		
8	1.996		
9	2.783		
10	3.400		
Total Item Variance	15.717		

Based on table 3, which details the findings of the reliability analysis performed using Microsoft Excel on ten integrated questions, the reliability value was determined to be in the high category with a r alpha of 0.686.

Table 4: Difficulty level

Question Number	Difficulty Index	Classification
1	0.617	Medium
2	0.500	Medium
3	0.717	Easy
4	0.433	Medium
5	0.667	Medium
6	0.483	Medium
7	0.700	Medium
8	0.817	Easy
9	0.750	Easy
10	0.833	Easy

According table 4, it can be determined that the items fall into the categories of "medium" and "easy," while table 5 details the distribution of difficulty levels.

Table 5: Distribution by level of difficulty

Classification	Question Points	Total	Percentage
Medium	1, 2, 4, 5, 6, and 7	6	60 %
Easy	3, 8, 9, 10	4	40%

According to table 5, the classification of moderate goods is more prevalent than easy items.

Table 6: Distinguishing power

Question Number	Index	Criteria
1	0. 500	Good
2	0. 438	Good
3	0. 438	Good
4	0. 250	Sufficient
5	0. 313	Sufficient
6	0. 313	Sufficient
7	0. 438	Good
8	0. 438	Good
9	0. 438	Good
10	0. 438	Good

According to table 6, three things meet sufficient criterion, while seven items meet good criteria.

4. Discussion

The defining stage is the first step that must be taken before the product design can be used as an assessment tool. This step consists of many stages, the first of which is front-end analysis, which is used to locate, identify, and define the fundamental issues faced during the learning evaluation process Biology. (2) Student analysis, which seeks to ascertain students' attainment of 21st century learning competencies. This assessment tool is intended to test the competence of students in the second year of high school who are between the ages of 16 and 17. Based on Jean Piaget's cognitive development stages, this age implies that pupils are now in the formal operational stage. (3) Material analysis seeks to discover, describe, and methodically collect the major concepts connected to the subject matter that students will do. (4) Task Analysis: The attainment of fundamental skills by students may be tested by first performing a task analysis, which serves as a reference in developing tasks for students to complete. (5) Objective analysis is the creation of learning objectives based on fundamental abilities and learning indicators. This is the ultimate level of analysis and serves as the primary focus for accomplishing development objectives.

The goal of this step is to create a design for the generated assessment instrument. At this stage, three (three) stages are taken: the preparation of the benchmark reference test, the format selection, and the first design. The three stages yielded the following results: (1) Preparation of benchmark reference tests, which is based on material analysis and task analysis and is incorporated in accomplishment indicators. The planned test is a 10-question essay test. (2) The format of the material of the learning device is determined by the format chosen. As a result, a structure based on the concepts, characteristics, and evaluation procedures that incorporate critical and creative thinking skills is adopted. An introduction of the instrument, directions for using the instrument, a grid of questions, essay questions, scoring rubrics, question cards, and educator comments are among the components of

the assessment instrument product that have been produced. (3) Initial design, which includes all tasks that must be completed before proceeding to the validation stage. The design of the assessment instrument product relates to the findings of the analysis performed during the definition and other stages prior to the planning phase. This phase will result in a product in the form of an early prototype of the assessment instrument product that will be developed during the development stage. The validation sheet and the product in the form of an integrated assessment instrument for critical thinking skills, creative thinking abilities, and cognitive biology learning outcomes are the products of the assessment instrument's product design at this stage. Pixellab, Microsoft Word 2013, code creator, and Google Form are among the programs utilized in the creation of assessment instrument goods.

This stage seeks to generate the final form of the assessment instrument product that was produced during the planning stage in order to create a legitimate product following changes based on the validation stage by expert validator lectures. One of the primary factors for determining whether or not an assessment instrument's product is the outcome of expert validation. Experts are invited to validate the assessment instrument's final product, which was created during the design stage (initial prototype). Furthermore, the validator's recommendations and instructions are taken into account and used as a foundation. Experts will validate product validation sheets, evaluation devices, and produced goods. The created product is evaluated based on four (four) factors: content validation, concept, language or culture, and design.

How is the validity of the assessment instrument integrated with critical thinking, creative thinking, and cognitive biology learning outcomes? Based on the study's findings, it was determined that the produced product, namely an integrated assessment instrument for critical thinking skills, creative thinking abilities, and cognitive biology learning outcomes, is valid or suitable for use with minor changes. The findings of the validator lecturers' and education experts' evaluations are used to determine the product validity. With a valid category, the validator lecturers' average assessment is (4.41). Based on the validation results, it is concluded that the product of the critical thinking skills assessment instrument, which integrated creative thinking skills and cognitive biology learning outcomes, is suitable for use as an instrument for assessing students in class XI SMA/MA on immune system material.

Because of developments in science and technology, it is critical to design learning tools that focus on thinking abilities. According to [24], [25] good thinking abilities can be a powerful capital for students in Asia to be able to handle complicated challenges that occur in current times. As a result, it needs a process of thinking practice via answering questions that are geared to higher-order thinking abilities in order for students to be able to follow the growth of science and technology.

The use of assessment tools in 21st century learning, particularly in biology topics, is extremely beneficial for instructors when assessing the performance of intended competencies,

particularly in terms of fulfilling 21st century learning abilities. An evaluation method is used to evaluate the accomplishment of these abilities. HOTS is a feature of 21st century learning assessment (Higher Order Thinking Skill). HOTS (Higher Order Thinking Skills) tests are questions that examine abilities in the areas of analyzing (C4), evaluating (C5), and producing (C6) [26].

HOTS-oriented evaluations, according to [27], help both instructors and students. Students acquire knowledge by creating meaning and integrating new information into their mental representations. As a result, strengthening thinking abilities improves subject knowledge and comprehension. Educators must be capable of creating and developing excellent assessment tools in order to measure the capacity of objective and proportionate student learning outcomes [28]. As a result, the goal of this project is to create a reliable integrated assessment tool for critical thinking abilities, creative thinking skills, and cognitive biology learning outcomes.

The product's validity is anticipated to be utilized as a reference in measuring cognitive learning outcomes through strengthening critical and creative thinking abilities. Furthermore, as a motivator to enhance assessment abilities. The topic of this conversation is a discussion of the findings of the research on the product of the produced assessment instrument. The created product is an integrated assessment instrument for critical thinking skills, creative thinking skills, and cognitive biology learning outcomes, with this assessment instrument based on 21st century learning abilities, specifically critical thinking skills and creative thinking skills.

The development of an integrated assessment instrument product which includes critical thinking skills, creative thinking skills and biology learning outcomes has met the valid aspects so that it is hoped that in the future teachers and students can use this product optimally as an assessment instrument that accurately evaluates the empowerment of the learning process that supports the realization of skills. 21st century learning, especially critical thinking skills and creative thinking skills. However, due to the researcher's constraints, this research did not reach the dissemination stage, which implies it has not yet been evaluated for practicality and efficacy. It is hoped that additional study on the product of this assessment instrument will be conducted to perform a practical test and evaluate the efficacy of this assessment instrument, so that it may later finish this research. The deployment phase is the last stage of development, according to [29]. This stage's goal is to communicate the results of the research. The creation of an integrated assessment tool, in particular.

Previous study by [30], [31], states that the Problem-based Learning (PBL) learning method that is linked with the Reading, Questioning, and Answering (RQA) approach is referred to as PBLRQA. The combination of PBL and RQA to build a PBLRQA method demonstrates how they complement each other and optimize their potential for enhancing metacognitive skills. The learning approach has an effect on improving students' critical thinking abilities, and it has the greatest effect when combined with the PBL-Jigsaw

integration method. Each scoring rubric supplements the incorporation of indicators in the assessment tool.

According to [32], the critical thinking rubric, which was adapted from Finken and Ennis, is anticipated to be used as an alternative to the integrated critical thinking skills assessment essay exam. Assessment integration is critical to the current 2013 curriculum. This is confirmed by [33] that based on this integrated assessment development study, it is hoped that a test assessment instrument that contains two indicators can be developed directly. This integrated assessment is also expected to be an alternative assessment instrument that is feasible to use to measure the achievement of science process skills and thinking skills in the 2013 curriculum.

In order to develop high-quality questions and be able to assess students' abilities, it is necessary that the question writers pay attention to key aspects of test preparation, such as differentiating power and level of difficulty. The THB (Learning Outcome Test) items' Distinguishing Power (DB) measures their capacity to distinguish between students with high and poor skills. The question's ability to discriminate between students who already grasp and don't understand the topic improves with increasing discriminatory power [34], because the item's degree of difficulty and its ability to discriminate have a relationship. The discriminatory power of an item will be minimal if it has a maximum level of difficulty, and it won't have any if it is too simple. A test's capacity to discriminate between students who have learned the content being tested and those who have not [35] is known as its distinguishing power. Test items that have been evaluated for their degree of difficulty and distinctness are those that are suitable for use in data collection.

Finding out how easy or difficult the test is for pupils depends on its level of difficulty. Excel can be used to analyze the degree of difficulty and discriminative power by entering the appropriate formulas. The test items that have been examined for their degree of difficulty and differentiating power are the test items that can be utilized to gather data. To determine if a test is easy or tough for students, the level of difficulty is employed [36]. The capacity to differentiate between students of high ability and those of poor ability is known as distinguishing power. Reliability tests are performed on the results of measurements or observations if the facts or realities of life are measured or observed many times at different times, so reliability tests can be carried out with validity tests [37], [38]. Difficulty can be viewed as the ability or ability of students to answer the tests given. Discriminatory power is a measurement of an item's capacity to distinguish between high-ability students (those who grasp the content) and low-ability students (those who do not) [39]. By examining the size of the index number, it is possible to determine the discriminatory power of a query. Differentiating quality (IDP). The discrimination index number, which indicates the extent of the item's discriminatory power, can be used to identify distinctiveness.

The number of respondents in the higher group who provided the correct response is subtracted from the percentage of respondents in the lower group who provided the correct response to determine the differentiating power of each item

[40]. While the difficulty index is a numerical measure of each item's degree of difficulty. Both moderately difficult and moderately simple products are deemed to be good [41]. The size of a question's perceived difficulty by students and the fact that only a small number of students were able to correctly answer it are used to determine the items' relative levels of difficulty [42].

5. Conclusion

Based on the findings of research and development validation of an integrated assessment instrument for critical thinking skills, creative thinking skills, and cognitive biology learning outcomes on the material of the XI SMA/MA class XI immune system, it is declared valid after meeting the established validity indicators, namely the product in the form of an integrated assessment instrument. Based on the evaluation of two professional validator lecturers, it was deemed valid or acceptable for usage with small-scale changes. The product implication is that it may be utilized by students to measure their achievement of 21st century learning skills and by instructors to prepare Higher Order Thinking Skill assessments.

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