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INSTRUMENT ASSESSMENT IN STUDENT LEARNING OUTCOME FOR FACTUAL AND CONCEPTUAL HOTS ON SCIENCE EDUCATION

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ABSTRAK

Tujuan penelitian adalah memberikan gambaran kepraktisan HOTS faktual dan konseptual sebagai alat penilaian dalam konteks pendidikan IPA, serta profil hasil belajar siswa. Penelitian ini menggunakan model ADDIE sebagai kerangka model Penelitian dan Pengembangan (R&D). Peserta penelitian terdiri dari dua puluh orang yang duduk di kelas empat sekolah dasar di Bengkulu Tengah. Penelitian ini menggunakan panduan wawancara, angket, dan penilaian pemahaman konseptual dengan pertanyaan pilihan ganda. Penelitian ini menggunakan teknik analisis data yang melibatkan validasi ahli pada aspek materi, bahasa, konstruksi, dan reliabilitas, serta pemeriksaan hasil tes. Analisis deskriptif kuantitatif dilakukan untuk menilai profil prestasi belajar. Hasil penelitian menunjukkan bahwa terdapat instrumen penilaian keterampilan Berpikir Tingkat Tinggi pada faktual dan konseptual yang valid dan reliabel. Secara khusus, penelitian ini mengidentifikasi 15 dari 20 item asli yang memenuhi kriteria validitas dan reliabilitas. Soal tingkat kognitif dikategorikan menjadi tiga tingkatan, yaitu 40% masuk kategori C4, 33,33% masuk kategori C5, dan 26,67% masuk kategori C6. Studi ini juga menemukan bahwa 46,67% pertanyaan menilai pengetahuan faktual, sementara 53,33% menilai pengetahuan konseptual. Tingkat kognitif menganalisis memiliki profil tertinggi sebesar 88,33%, mengevaluasi sebesar 81%, dan mencipta sebesar 66,67%. Profil hasil belajar pengetahuan faktual sebesar 76,67%, sedangkan pengetahuan konseptual sebesar 72,22%.

Kata kunci: instrumen penilaian, faktual dan konseptual, keterampilan berpikir tingkat tinggi, hasil belajar, pembelajaran IPA.

ABSTRACT

The research objective is to provide a depiction of the practicality of factual and conceptual HOTS as an assessment tool in the context of science education, as well as the profiles of student learning outcomes. The present study employs the ADDIE model as a framework for Research and Development (R&D) model. The study's participants comprised of twenty in the fourth-grade from elementary school in Bengkulu Tengah. The research employed interview guides, questionnaires, and conceptual comprehension assessment with multiple-choice questions. The present study employs a data analysis technique that involves expert validation to material, language, construction, and reliability aspects, alongside the examination of test results. Quantitative descriptive analysis was conducted to assess the learning achievement profile. The study results indicate that there are valid and reliable instruments for assessing factual and conceptual Higher-Order Thinking skills (HOTs). Specifically, the study identified 15 out of the original 20 items that met the criteria for validity and reliability. The cognitive level questions were categorized into three levels, with 40% categorized in C4, 33.33% in C5, and 26.67% in C6. The study also found that 46.67% of the questions assessed factual knowledge, while 53.33% assessed conceptual knowledge. The cognitive level of analyzing had the highest profile at 88.33%, followed by evaluating at 81%, and creating at 66.67%. The profile of learning outcomes for factual knowledge was 76.67%, while that for conceptual knowledge was 72.22%.

Keywords: assessment instrument, factual and conceptual, Higher-Order Thinking skills (HOTs), learning outcome, science learning

I. INTRODUCTION

The regulations from Ministry of Education and Culture's No. 20 in 2016 outline the competency standards for elementary school students. These standards pertain to the dimensions of factual and conceptual knowledge in the areas of science, technology, art, and culture at a basic level. Additionally, students are expected to demonstrate the ability to connect these knowledge dimensions to their personal lives, families, schools, communities, natural environment, nation, and state (1). The 2013 curriculum places students in the role of active knowledge constructors who utilize a scientific approach to develop Higher-Order Thinking Skills (HOTs).

The Ministry of Education and Culture's No. 23 in 2016 guidelines the evaluation of student learning outcomes is intended to facilitate the enhancement of higher-order cognitive abilities among students (2). Science is included as a subject matter in elementary school curricula. It encompasses both factual and conceptual knowledge, which can offer valuable opportunities for meaningful learning experiences among young learners. According to the 2013 curriculum, students are expected to possess the ability to forecast, formulate, and approximate. The HOTs dimension encompasses the cognitive operations of analyzing (C4), evaluating (C5), and creating (C6). Furthermore, science education with scientific HOTs plays an important role in the science learning process (3).

Assessment provides an essential part in the learning process as it serves multiple purposes (4). Firstly, it aids in making significant decisions concerning students, such as evaluating their level of completeness in achieving learning objectives. Secondly, it serves as a motivational tool for students, encouraging them to enhance their academic performance and cultivate positive attitudes towards learning. Lastly, it provides benchmarks for teachers to assess the students' learning level and the effectiveness of learning methodologies (2). Consequently, it is imperative to have an assessment tool that satisfies the established eligibility requirements. A written test in the form of multiple-choice is used as an instrument to assess cognitive learning achievement during the semester evaluation or summative test (5,6).

The multiple-choice test is defined as a type of assessment where examinees are presented with a set of alternatives and are required to select the correct answer. This format of testing is characterized by the availability of all necessary information within the test. Multiple-choice test is a form of assessment that presents a series of statements or questions related to factual knowledge, conceptual understanding, procedural skills, or metacognitive abilities (7). Multiple-choice questions are a type of inquiry that presents a set of options for respondents to choose (8). This question format offers several benefits, including its ease of scoring, rapidity, and high level of objectivity (9,10). Additionally, it is capable of measuring various cognitive levels and encompasses a wide range of material. This format is particularly suitable for large-scale assessments that require immediate reporting of results, such as national and school final exams. The multiple-choice question format presents certain drawbacks, including the protracted time required to formulate the questions, the challenge of creating distractors that are uniform in nature, and the possibility of test-takers guessing the correct answer (11).

A compatibility between the indicators of the items being assessed and the requirements for factual and conceptual knowledge in curriculum as core knowledge competencies must be ensured (12). The elements of the problem indicators that require consideration are the subject, the behavior under evaluation, and the condition or context (8). The procedure for constructing a school examination grid involves three steps (8). Firstly, an analysis of the fundamental competencies outlined in the subject's curriculum is conducted. Secondly, the scope of the material is categorized into three cognitive levels, namely knowledge, application, and reasoning. Lastly, the material is mapped into cognitive levels that are aligned with basic competencies outlined in the curriculum.

The assessment system must be able to continuously provide information about student learning outcomes (13). The HOTs assessment has three traits: (1) evaluates HOTs abilities; (2) raises contextual issues; and (3) uses a variety of questions. When teachers and schools make decisions about the accomplishment of student learning outcomes, the position of the learning outcomes assessment instrument is particularly important. According to research findings, teachers

have trouble creating HOTs questions (14).

The aim of this research is to explicate the feasibility of the HOTs assessment tool in the context of science education for fourth-grade students in primary schools. Additionally, the research seeks to ascertain the proportion of cognitive levels of analyzing, evaluating, and creating. The assessment instrument, as well as the percentage of factual and conceptual knowledge dimensions are incorporated into the assessment tool. Furthermore, the research endeavors to delineate the learning outcomes profile in relation to the cognitive level of analyzing, evaluating, and creating, as well as the profile of learning outcomes concerning factual and conceptual knowledge.

II. METHODS

The cognitive learning outcomes involve the sensory processes that are registered and retained in the brain (15). Cognitive abilities in the knowledge dimension can be categorized into two types: factual and conceptual (16). Factual elements serve as the fundamental knowledge that students must possess to comprehend a particular discipline or to tackle problems within that discipline. On the other hand, conceptual elements refer to the interrelatedness of elements within a structured and detailed framework, which enables to operate and combine with one another.

The six levels of thinking processes, namely remembering, understanding, applying, analyzing, evaluating, and creating. It formulated to represent knowledge and thinking processes from Revised Bloom Taxonomy (RBT) by Lorin Anderson and David Krathwohl (17). The process of generating HOTs questions using RBT involves these steps: (1) the teacher identifies the question behavior that is to be assessed and devises a stimulus that will serve as the questions foundation; (2) the stimulus is presented within a specific context that aligns with the anticipated behavior; (3) the availability of high-level reasoning prompts in textbooks is not always guaranteed; (4) effective question writers demonstrate a flexible and comprehensive understanding of the material, determining from sources besides textbook; (5) a structured framework for question writing is established through the creation of a question grid; and (6) the teacher's ability to creatively select appropriate stimulus questions based on the unique circumstances of the educational setting is crucial.

The study was carried out at Elementary School in Bengkulu Tengah, consisting of 21 participants. The total number of individuals in Class IV was 20. This study is designing a HOTs in science assessment tool centered on the theme of "Save Living Things". It held in the first semester in 2021-2022 academic year for seven months, specifically from April to October 2022. The present study pertains to research and development, specifically utilizing the ADDIE model that encompasses five phases, namely analysis, design, development, implementation, and evaluation. The ADDIE model comprises distinct stages in the development process (16). The primary undertakings encompassed in this study are as follows: (a) the examination of students' final assessment, and (b) the analysis of learning outcomes with interviews conducted by teachers.

The proposed methodology involves the development of indicators and HOTs instrument grids, followed by the multiple-choice question with four answer choices. Expert validator questionnaires will then be prepared to assess the material, language, constructs. Also, the student readability validation sheets will be compiled. At this stage, the process of development is underway. The process of creating multiple-choice questions involves several steps. Firstly, the questions are formulated with four answer choices. Secondly, experts are consulted to validate the questions in terms of their subject matter, language, and construct. Thirdly, the results of the validation process are analyzed for each aspect. Finally, the question data is summarized or revised based on the input and suggestions provided by the validators. During the implementation stage, an empirical testing was conducted on other class in fourth-grade students at elementary school No. 21 Bengkulu Tengah. The research data will be subjected to analysis in order to ascertain the test's validity, reliability, discriminatory power, and difficulty level. The aim of this study is to assess the efficacy of the HOTs instrument in determining the cognitive learning outcomes at levels C4, C5, and C6, as the factual and conceptual dimensions of students.

The techniques employed for data collection include tests, interviews, surveys, and documentation. The study employed research instruments comprising factual and conceptual HOTs

test instruments for Class IV in science learning, administered at the conclusion of second semester in 2022. The present study involves interviews with fourth-grade teachers to gather information pertaining about the HOTs instrument. This interview guidelines have been developed for the purpose of facilitating the data collection process. The questionnaire, a survey methodology, is employed to ascertain the validation responses of factual and conceptual HOTs assessment tools. The present document pertains to the documentation and data obtained from assessment conducted by teachers during the first semester in 2022, as part of the final assessment program.

III. RESULT AND DISCUSSION

Feasibility of HOTS factual and conceptual assessment instruments

This study presents the validation of HOTs science assessment tool, comprising 20 multiple-choice questions that evaluated by six experts and practitioners. They are assigned to evaluate about material, construction, and language. The evaluation of each item is conducted through Likert scale with numerical values ranging from 1 to 4. Subsequently, the outcomes are subjected to analysis utilizing the Aiken V formula.

The results of expert validation demonstrate that the items' validity related to the material aspect ranges from 0.72 to 0.94. The construction aspect's has validity index value ranges from 0.87 to 1.00. Additionally, the language aspect's has validity index value ranges from 0.71 to 1.00. According to these validations, all of the items have satisfied the validity criteria.

The items demonstrate validity and effectively contribute to the overall validity, as indicated by a validity index greater than 0.444. The implementation of content validation procedures, modifications were performed on the three dimensions of evaluation, specifically the material, construction, and language components. Regarding language, it is recommended to revise the ineffective sentences in order to avoid confusion among students and to review the use of punctuation marks. Regarding the construction aspect, the images is conducted in accordance with their correlation to the subject matter. The present study involves the evaluation by validator, which evaluated through an assessment based on McHugh's model (18). The findings from validator analysis in the material aspect reveal that 5% of the 20 questions were interpreted as "Less", 15% as "Moderate", 30% as "Strong", and 50% as "Very strong". Regarding the linguistic dimension, a quarter of the inquiries are construed as "Strong," while three-quarters are construed as "Very strong." Additionally, 35% of inquiries are interpreted as "Very strong."

(a) Question Validity

The testing results are computed utilizing the product moment formula and subsequently referencing r_{table}. An instrument is considered valid when $r_{count} > r_{table}$ at a 5% significance level. The analysis reveals that there are a total of 20 questions, out of which 75% belong to the valid category while the remaining 25% belong to the invalid category. The researcher opted to exclude questions that were empirically invalid, resulting in a final set of 15 questions for use in the study.

(b) Question Reliability

An instrument is considered reliable if its value exceeds 0.70 (16). The KR-20 coefficient of reliability for the test data was determined to be 0.89, which exceeds 0.7. The questions' reliability is a crucial aspect in various study to produce valid and reliable research findings. It refers to the ability of a question to differentiate between individuals or groups based on their responses. This concept is particularly relevant in fields such as psychology, education, and market research, where the goal is to obtain accurate and meaningful data. The questions' reliability can be assessed through statistical analysis, which allows researchers to determine the extent to which a question is able to distinguish between different groups.

c) Discriminating Power of Questions

The assessment of discriminating power is classified as follows: if the value is less than 0.20, deemed "Bad"; if it within the range of 0.20-0.40, considered "Enough"; if it lies between 0.41-0.70, regarded as "Good"; and if it ranges from 0.71-1.00, classified as "Very Good" (16). The analysis has revealed that six questions with "bad" discrimination, six questions

categorized as "Enough", and eight questions categorized as "Good".

d) Problem Difficulty Level

The analysis findings indicate that the 20 questions possess "Easy" level of difficulty, with a total of 9 questions falling under this category. Eleven questions were classified as having a moderate level of difficulty.

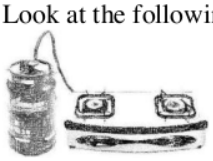
When developing multiple-choice questions, it is important to select a stimulus item. The stimuli are contextual, relevant to daily life problem, capable of capturing the student's attention, and encouraging to engage with the questions. Various types of stimuli, including textual information, images, and tables, can be utilized to contextualize natural science material.

The analysis of factual and conceptual HOTs in science assessment instruments has meet the competency standards and the criteria for validity, reliability, differentiating power, and level of difficulty. The evaluation tool designed to measure HOTs in science has been deemed valid and reliable based on criteria related to its material, construction, and language. The tool has been classified as "very good" and can effectively assess the students HOTs. The results of this investigation are consistent with the concept of content validation, which pertains to the logical feasibility of the material, structure, and language components. The procedures employed in compiling the assessment instruments for this study align with the guidelines for formulating questions on HOTs which involve identifying the fundamental competencies and subject matter to be evaluated, organizing grids, devising question indicators, and composing questions in accordance with established principles of question writing (19).

The proportion of cognitive levels analyses, evaluates, and creates on HOTs assessment

The results of basic competency analysis indicate proficiency in several areas. Firstly, the individual is able to compare the life cycles of various living things and draw connections for conservation. Secondly, they are capable to identify different types of forces, such as muscle, electric, magnetic, gravitational, and frictional forces. Thirdly, they can relate these forces to motion and events in the surrounding environment. Fourthly, they possess an understanding of various sources of energy, their transformation, and alternative energy sources, including wind, water, solar, geothermal, organic fuels, and nuclear energy. Finally, they are able to apply their knowledge of sound properties and their relation to the sense of hearing. The subsequent phase involves the selection of stimulus, wherein the researcher seeks out a compelling stimulus that motivates students. The choice stimulus should be novel to the students and be reflective of real-life problems. The researcher created an assessment tool consisting of contextual descriptions, pictures, and tables aligned with the basic competencies. The percentage of questions shows questions with cognitive level: (1) analyzing (C4) 6 items out of 20 questions or 40%; (2) comparing (C5) 5 items out of 15 items or 33.33%; and (3) created (C6) as many as 4 items or 26.67%. The example of a stimulus in question number 15 is the level of analysis (C4) presented in Table 1.

Table 1. The example of a stimulus question based on cognitive level

No	Question	Multiple-choice
1	**Stimulus for analyze (C4)**	
	Look at the following picture  This picture depicts a gas cylinder and a stove. Which the sequence form of energy is actually utilized in the illustrated image?	A. Chemistry – light – heat B. Chemistry – heat – light C. Sound – chemistry – heat D. Heat – light – sound Answer: B. Chemistry – heat – light
2	**Stimulus for evaluate (C5)**	

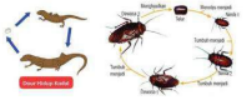
No	Question	Multiple-choice
	The following shows two people riding bicycles! From the picture, bicycle A rides a bicycle on an asphalt road, while bicycle B on a sandy road. When A and B do the race, what is the state of the force that affects each of these cyclists! A.  B. 	A. cyclist A will be slower than cyclist B B. cyclist B will be faster than cyclist A C. cyclist B will be as fast as cyclist A D. cyclist A will be faster than cyclist B Answer: D. cyclist A will be faster than cyclist B
3	**Stimulus for create (C6)**	
	The following picture shows a child climbing a mango tree to get the fruit. Other friends caught the fruit that was picked. What force does this activity use. 	A. Resilience and friction B. Muscles and gravity C. Gravity and resilience D. Resilience and friction Answer: B. Muscles and gravity

The science assessment tool developed by the HOTs stages. The indicators of HOTs encompass the cognitive processes of analysis, evaluation, and creation (20). This study formulate achievement with HOTs indicators for enrichment competencies at the reasoning level. The process of analyzing involves organizing the information into smaller components in order to identify patterns or connections. This enables one to identify and determine the causes and effects of a numerous situation. The act of evaluation involves the utilization of predetermined criteria and standards to make a decision. The act of evaluation involves the capacity to arrive at conclusions using established standards. The act of creation involves the combination of various components to produce a novel and integrated unit or to generate an innovative output. Students engage in the process of synthesizing elements to create a cohesive and operational entity, as well as restructuring said elements into novel configurations through the activities of creating, organizing, or producing.

The proportion of factual and conceptual knowledge in HOTs assessment

The proportion of factual knowledge aspects in the assessment instrument shows as many as 7 items or 46.67% of 15 items and conceptual as many as 8 items or 53.33% of 15 items. Examples of questions measuring the factual and conceptual knowledge are presented in Table 2.

Table 2. The examples of questions measuring the dimensions of factual and conceptual knowledge

No	Question	Multiple-choice
1	**Factual knowledge**	
	The picture below shows the 2 life cycles of animals, lizards and cockroaches!  The two pictures above show that there is a difference in which statement appropriate for the animal life cycles.	A. Lizards do not undergo metamorphosis while cockroaches do incomplete metamorphosis. B. Lizards undergo incomplete metamorphosis while cockroaches do undergo complete metamorphosis. C. Lizards do not undergo metamorphosis while cockroaches do complete metamorphosis. D. Lizards and cockroaches both undergo incomplete metamorphosis. Answer: A. Lizards do not undergo metamorphosis while

No	Question	Multiple-choice
		cockroaches do incomplete metamorphosis.
2	**Conceptual knowledge**	
	The list below shows the animals life cycles. 1. Cat and Fish 2. Butterflies and Mosquitoes 3. Frogs and Flies 4. Fish and Grasshopper Based on the table above, animals that undergo complete metamorphosis in life cycle?	A. 1 and 2 do not change shape in their life cycle. B. 1 and 3 undergo shape changes in their life cycle. C. 2 and 3 experienced a change in shape in their lives. D. 2 and 4 did not change shape in their lives. Answer: C. 2 and 3 experienced a change in shape in their lives.

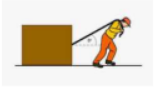
The content and context from the dimensions of factual and conceptual knowledge can be evaluated with regards to their material scope. It can be observed through the item stimulus, the options for correct answers, and the options for incorrect answers (21). The prevalence of HOTs in assessment tools remains limited (22). The cognitive level of the students, as measured, remained at LOTs. Less than 50% of the school exam items' attributes pertaining to the stimulus category are represented by visual representations, whereas a minor proportion is comprised of tables, illustrations, and incomplete case studies. It was discovered that a high proportion of the items, specifically 97.5%, were in alignment with the indicators for competency achievement.

Level learning outcomes profile of analyzing, evaluating, and creating students in science learning

The learning outcomes assessed in the cognitive domain. There are the cognitive domains of analyzing level (C4) reached 88.33%, comparing level (C5) reached 81%, and creating (C6) reached 66.25%. An example of question for the analysis level reaching 100% of students can answer correctly is presented in Table 3.

Table 3. The examples of questions measuring the dimensions of factual and conceptual knowledge in cognitive level

No	Question	Multiple-choice
1	**Factual knowledge in analyze level (C4)**	
	Pay attention to the following activities! 1 Ride the bike 2. Step on the gas pedal of the car 3. Hoisting the flag 4. Open the bottle 5. Lifting the table 6. Kick the ball 7. Carrying a child 8. Draw Water 9. Close the Refrigerator Door From the table above which activities use force energy?	A. 1, 2 and 7 B. 2, 3 and 9 C. 1, 2 and 6 D. 1, 2 and 8 Answer: C. 1, 2 and 6
2	**Conceptual knowledge in create level (C6)**	
	The picture below shows the activity to pull an object	A. The friction force in figure 1 is greater than the friction force in figure 2 so it feels heavier in picture 2 B. The friction force in figure 1 is greater

No	Question	Multiple-choice
	1  2  From the picture above, why does the load be pulled in figure 1 was heavier compared to figure 2?	than the friction force in figure 2 so it feels heavier in picture 1 C. The friction force in figure 1 is smaller than the friction force in figure 2 so it feels heavier in picture 1 D. The friction force in figure 1 is smaller than the friction force in figure 2 so it feels heavier in picture 2 Answer: B. The friction force in figure 1 is greater than the friction force in figure 2 so it feels heavier in picture 1

The analysis of learning outcomes profile is determined by the proportion of student attainment at each level. It indicates that the highest level of achievement is observed in the domain of analysis, followed by evaluation. While the lowest level of achievements is observed in the domain of creation. The skill of analysis refers to an individual's capacity to deconstruct a given substance or scenario into constituent components, and comprehend the interrelationships between these components or factors.

The dimension of analytical thinking process entails that students possess the capacity to identify various aspects or elements, articulate them, arrange them in an organized manner, draw comparisons, and deduce implicit meanings. This dimension is denoted as C4. The present inquiry involves an item of stimulus that takes the shape of a roster of routine undertakings executed by students, followed by a prompt to scrutinize activities that exhibit propulsion. In order to assess this inquiry, students must possess the ability to form assessments grounded in established criteria and standards (23). The dimension of evaluating thinking processes (C5) necessitates that students possess the capacity to generate hypotheses, engage in critical analysis, make predictions, evaluate, test, provide justifications, and assign accountability (24,25).

The dimension of creative thinking process (C6) necessitates that students possess the capacity to engage in designing, constructing, strategizing, generating, innovating, revising, refining, enhancing, embellishing, and composing. None of the four items presented were answered with 100% accuracy by the students. The task assigned to students is to articulate their ideas by means of a textual statement that captures the relationship depicted in the image. In order to equip students with the ability to answer questions presented in international standard formats, educators integrate a range of reasoning components into their teaching methodology. These components include analysis, synthesis, investigative design, question formulation, evaluation, conclusion drawing, generalization, and justification.

Student factual and conceptual dimensions of learning outcomes in science

Learning outcomes in the cognitive aspect of factual knowledge reach a percentage of 76.67% and conceptual aspects reach 72.22%. Example question number 10 measuring cognitive level comparing conceptual 100% of students can answer correctly. Example questions are presented in Table 4.

Table 4. The examples of questions for comparing conceptual

Question	Multiple-choice
The treatment on magnet: 1) beaten 2) soaked into water 3) electrified 4) coated with paint	A. 1, 2, 3 B. 1, 3, 5 C. 1, 2, 4 D. 2, 4, 5

Question	Multiple-choice
5) burned What are the treatments can eliminate the magnetism of magnet?	Answer: B. 1, 3, 5

The analysis of students' achievement in the aspects of factual and conceptual knowledge is conducted by examining the percentage of learning outcomes in each respective area (26). The acquisition of scientific knowledge in primary education is guided by a set of fundamental competencies that encompass the instruction of factual information, conceptual understanding, fundamental principles, and theoretical frameworks (27). When assessing the proficiency of students, the exam questions incorporate factual information, conceptual understanding, content knowledge, and contextual relevance, as these aspects of learning are interconnected. The acquisition of fundamental scientific knowledge in primary education necessitates a comprehensive grasp of the factual and conceptual dimensions of core competencies.

The findings indicate that the attainment of factual knowledge is greater, specifically at a rate of 76.67%, while conceptual knowledge is achieved at a rate of 72.22%. It is possible for all students to answer the factual question item in Table 2 with complete accuracy. In relation to Table 1 which pertains to the factual aspects of LPG gas cylinders connected to gas stoves, students were tasked with demonstrating the progression of energy transformations involving chemistry, heat, and light. It was discovered that 50% of the students provided erroneous responses. A significant number of students tend to select an incorrect option when presented with the sequence of energy transformations involving chemical, light, and heat.

Conceptual item indicates that there was a 50% incorrect response rate among the student population. The aforementioned item is utilized as a means of provocation in the visual format, prompting students to formulate a concept in the form of an original statement that pertains to the level of creation. This finding suggests that there is a relationship between cognitive level and both factual and conceptual aspects of image or text stimuli. This implies that the degree of analysis demonstrates greater proficiency in contrast to evaluation, not to mention creation. The acquisition of factual knowledge is a fundamental component of cognitive products that students must possess in order to effectively engage with scientific disciplines and successfully tackle problems. There is a positive correlation between conceptual knowledge and procedural knowledge (28). The attainment of student learning outcomes is more likely to be enhanced by a strong grasp of factual knowledge as opposed to conceptual understanding. The relationships among the constituent elements in a sophisticated and structured system enable their collaborative functioning

IV. CONCLUSION

This study developed of assessment instruments in science lessons, which are based on HOTs and encompass factual and conceptual knowledge. It involved the identification of fundamental competencies and materials, the organization of grids, the formulation of question indicators, and the composition of questions in adherence to established guidelines for constructing multiple-choice questions. The eligibility criteria for these instruments were satisfied through logical considerations by experts in material, construction, and language, as well as through the fulfillment of criteria for validity, reliability, level of difficulty, and distinguishing power.

The distribution of questions based on cognitive level indicates the prevalence of questions categorized by cognitive level. The study involved the analysis of 40% of the total 20 questions, specifically 6 items, under the category C4. Additionally, 33.33% of the 15 items, or 5 items, were compared under category C5. Furthermore, 4 items were created, accounting for 26.67% of the total items, under category C6. The evaluation tool indicates that there are 7 factual knowledge aspects, which accounts for 46.67% of the total 15 items. Additionally, there are 8 conceptual aspects, which represent 53.33% of the total 15 items. The cognitive domain of analyzing level (C4) exhibits a profile of learning outcomes that attains 88.33%. In comparison, the level of learning outcomes for the domain of comparing reaches 81%, while the domain of creating (C6) demonstrates a learning outcome profile of 66.25%. The cognitive aspect of factual knowledge and

conceptual understanding exhibit learning outcomes at a rate of 76.67% and 72.22%, respectively.

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