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Development and preliminary validation of a physical education cognitive test across lower-, middle-, and higher-order thinking skills in students aged 12-15 years

Desarrollo y validación preliminar de una prueba cognitiva de educación física que evalúa las habilidades de pensamiento de orden inferior, medio y superior en estudiantes de 12 a 15 años

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Abstract

Physical Education cognitive assessment requires validated instruments that capture not only factual knowledge but also students' ability to apply and evaluate concepts in movement-related contexts. This study aims to develop and conduct a preliminary validation of a Physical Education cognitive test based on Lower-Order Thinking Skills (LOTS), Middle-Order Thinking Skills (MOTS) and Higher-Order Thinking Skills (HOTS) for students aged 12-15 years. This study employed a quantitative approach in the development and preliminary validation of the instrument. Content validation involved nine validators, comprising four lecturers and five Physical Education teachers from pilot schools. The empirical pilot study involved 722 students who returned complete and codable answer sheets in grades 7, 8 and 9 from five junior high schools. The instrument developed comprises 47 LOTS items, 35 MOTS items and 33 HOTS items, each with four answer options. The topics covered include big ball games, small ball games, athletics, gymnastics, physical fitness, pencak silat, healthy lifestyles and injury prevention. Content validity was analysed using Aiken's V, whilst internal reliability was analysed using the Kuder-Richardson 20 (KR-20) formula. The results showed that Aiken's V ranged from 0.852 to 0.889, with an overall value of 0.870. The overall KR-20 value was 0.687, whilst the KR-20 values for LOTS, MOTS and HOTS were 0.573, 0.515 and 0.609, respectively. These results indicate that the instrument possesses strong evidence of content relevance and limited-to-moderate preliminary internal consistency. Therefore, the test may serve as a preliminary basis for further item refinement, Physical Education cognitive item-bank development, and broader psychometric validation.

Keywords: cognitive tests; physical education; LOTS-MOTS-HOTS; educational assessment; educational measurement

Resumen

La evaluación cognitiva en Educación Física requiere instrumentos validados que capturen no solo conocimientos factuales, sino también la capacidad de los estudiantes para aplicar y evaluar conceptos en contextos relacionados con el movimiento. Este estudio tiene como objetivo desarrollar y realizar una validación preliminar de una prueba cognitiva de Educación Física basada en habilidades de pensamiento de orden inferior (LOTS), de orden medio (MOTS) y de orden superior (HOTS) para estudiantes de entre 12 y 15 años. Se empleó un enfoque cuantitativo para el desarrollo y la validación preliminar del instrumento. La validación de contenido contó con la participación de nueve validadores: cuatro docentes universitarios y cinco profesores de Educación Física de escuelas piloto. El estudio piloto empírico incluyó a 722 estudiantes de los grados 7, 8 y 9, pertenecientes a cinco escuelas de educación secundaria, que entregaron hojas de respuestas completas y codificables. El instrumento desarrollado consta de 47 ítems LOTS, 35 ítems MOTS y 33 ítems HOTS, cada uno con cuatro opciones de respuesta. Los temas abordados incluyen juegos con pelotas grandes, juegos con pelotas pequeñas, atletismo, gimnasia, condición física, pencak silat, estilos de vida saludables y prevención de lesiones. La validez de contenido se analizó mediante la V de Aiken, mientras que la fiabilidad interna se evaluó utilizando la fórmula Kuder-Richardson 20 (KR-20). Los resultados mostraron que la V de Aiken osciló entre 0,852 y 0,889, con un valor global de 0,870.



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El valor global de KR-20 fue de 0,687, mientras que los valores de KR-20 para LOTS, MOTS y HOTS fueron 0,573, 0,515 y 0,609, respectivamente. Estos resultados indican que el instrumento presenta pruebas sólidas de relevancia de contenido y una consistencia interna preliminar de nivel limitado a moderado. Por consiguiente, la prueba puede servir como base preliminar para el refinamiento de los ítems, el desarrollo de un banco de ítems cognitivos de Educación Física y una validación psicométrica más amplia.

Palabras clave: pruebas cognitivas; educación física; LOTS-MOTS-HOTS; evaluación educativa; medición educativa

Introduction

Physical Education plays a vital role in supporting the development of junior school students aged 12–15. This is because, during this phase, students are going through the transition to early adolescence, a period in which they require opportunities to learn about movement, acquire health knowledge, develop positive attitudes and reinforce the habit of leading an active lifestyle (Kartini et al., 2024). High-quality physical education is not only focused on improving motor skills and physical fitness, but also contributes to students' cognitive, affective, social and psychological development through structured and meaningful learning experiences (Dudley et al., 2022). In the school context, Physical Education is also closely linked to the development of physical literacy, namely students' ability to understand, appreciate and actively participate in physical activity throughout their lives (Ridha et al., 2025; Nevitaningrum et al., 2026). Therefore, physical education in junior high school should be understood as a holistic educational process that assesses not only motor skills but also students' understanding of the concepts, rules, strategies, safety and benefits of physical activity.

The cognitive domain is a key component of Physical Education, as students' success in physical activities is determined not only by their ability to perform movements, but also by their understanding of movement concepts, the rules of games, training principles, simple strategies, safety in sport, and healthy lifestyle behaviours (Kayrgozhin et al., 2022; Abduljabar et al., 2025). Students with stronger cognitive understanding are expected to make more appropriate decisions during games, understand the learning objectives of physical activities, and connect physical activity with health and everyday life. In the field of physical literacy, the cognitive aspect is regarded as one of the key domains that supports children's active



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engagement in physical activity (Kurniawan et al., 2024), although research on measuring the cognitive domain remains more limited than that on the physical and affective domains (Shearer et al., 2021). For this reason, the development of cognitive tests in Physical Education is necessary so that teachers can obtain information not only about students' motor performance, but also about the conceptual understanding that supports their participation in physical activities.

Although the cognitive domain is important, assessment practices in Physical Education in schools still tend to focus predominantly on psychomotor aspects, such as technical skills, physical fitness and motor performance. Cognitive assessment is often carried out using questions devised by teachers on a practical basis, but these have not always undergone a systematic process of content validation and reliability testing (Levin et al., 2025). This situation may mean that assessment results do not yet fully and accurately reflect students' cognitive abilities. A systematic review in Indonesia indicates that research into and the implementation of physical literacy in Physical Education still tend to focus on motor skills, whilst the cognitive and affective dimensions have not yet been comprehensively developed through standardised instruments (Ridha et al., 2025). Furthermore, a study on Physical Education assessment at junior high school level indicates that cognitive assessment can be used to map students' learning outcomes; however, the development of psychometrically robust instruments still requires attention (Muhson et al., 2024).

The development of cognitive tests in Physical Education must take into account the varying levels of students' thinking, so that test items measure not only the ability to recall facts or definitions, but also the ability to understand, apply, analyse and evaluate situations within the context of physical activity. Within this framework, Lower-Order Thinking Skills can be used to assess basic abilities such as recalling and understanding concepts; Middle-Order Thinking Skills can be positioned as an intermediate cognitive category that assesses students' ability to apply concepts, select appropriate procedures, and use knowledge in contextual learning or game situations; whilst Higher-Order Thinking Skills can be used to assess the ability to analyse, evaluate and make decisions within the context of Physical Education (Ritonga et al., 2021; Pisiwati et al., 2024). This distinction is educationally important because



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Physical Education learning often requires students to move from basic conceptual recognition to practical application before they are expected to analyse tactical situations or evaluate movement-related decisions. Strengthening HOTS is important because higher-order thinking skills are linked to problem-solving, critical thinking, metacognition, collaboration and innovation in K-12 education (Liu et al., 2024). In the context of Physical Education, the stimulation of higher-order thinking skills (HOTS) is also considered important because school-age students require support from teachers and appropriate resources to be able to develop higher-order thinking skills through movement-based learning activities (Hardiansyah et al., 2025).

However, cognitive assessment instruments for Physical Education aimed at junior high school students aged 12–15 years, specifically developed on the basis of lower-, middle-, and higher-order thinking skills, remain limited, particularly those that have undergone content validation by experts and preliminary empirical reliability analysis based on students' responses. Several previous studies have developed HOTS-based cognitive assessment instruments in the context of sport or Physical Education, but these remain limited to specific subjects and topics, such as small-sided games and Sport Education students (Hadinata et al., 2024). Furthermore, a review of physical literacy assessment studies shows that there are still far fewer instruments that explicitly measure the cognitive domain than those for the physical and affective domains (Shearer et al., 2021). This gap highlights the need to develop cognitive assessment tools for Physical Education that are better suited to the characteristics of junior high school students, incorporate a variety of levels of thinking, and have adequate preliminary validity evidence.

Preliminary validation is a crucial stage in the development of cognitive test instruments to ensure that each item used is fully aligned with the subject matter, learning indicators, level of thinking, clarity of language, accuracy of the correct answer, and the appropriateness of the answer options. Aiken's V can be used to obtain evidence of content validity based on expert assessment of item quality, so that items that are less relevant or less clear can be revised before being administered to students (Wedi et al., 2025). Once content validity has been established, the students' responses need to be analysed to determine the test's internal consistency. In the



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context of multiple-choice tests scored dichotomously-that is, as correct or incorrect - the Kuder-Richardson Formula 20 (KR-20) can be used to test the reliability of the instrument (Arriah & Romba, 2023). This reliability analysis is important to provide preliminary evidence of the consistency of the test items in measuring students' cognitive abilities in Physical Education. Thus, the combination of Aiken's V and KR-20 can provide preliminary evidence regarding the test's content validity and reliability before the instrument is used more widely in learning assessment.

Based on this analysis, this study aims to develop and conduct a preliminary validation of a Physical Education cognitive test based on LOTS, MOTS and HOTS for junior high school students aged 12–15 years. The preliminary validation was carried out in two main stages: content validation by experts using Aiken's V, and testing the reliability of the instrument using KR-20 based on students' responses. It is hoped that this study will produce a Physical Education cognitive test instrument that is content-valid, has preliminary evidence of internal consistency, and is appropriate to the developmental characteristics of junior high school students. Furthermore, the results of this study can provide practical contributions to Physical Education teachers in designing more systematic cognitive assessments, whilst also serving as a foundation for further item refinement, question-bank development, and broader psychometric validation in subsequent research phases.

Method

Study Design

This study employs a design for the development and preliminary validation of an instrument aimed at producing a Physical Education cognitive test based on Lower Order Thinking Skills (LOTS), Middle Order Thinking Skills (MOTS) and Higher Order Thinking Skills (HOTS) for junior high school students aged 12–15 years. The primary focus of this study is not to test the effectiveness of learning, but rather to develop, analyse and assess the initial suitability of cognitive test items for Physical Education. Therefore, this study is structured around two main stages: content validation by experts and an initial empirical test of the items with students through the administration of a paper-based test.



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This research employed a quantitative design with an initial psychometric validation approach. Content validation was carried out to obtain expert assessments of the alignment of each item with Physical Education material, learning indicators, the LOTS, MOTS and HOTS cognitive levels, linguistic clarity, the accuracy of the answer key, and the appropriateness of the answer options. Following the content validation and item revision stages, the instrument was pilot-tested with junior high school students to obtain empirical response data. This data was used to test the internal reliability of the Physical Education cognitive test using the KR-20, thereby providing preliminary evidence of content validity and internal consistency rather than evidence of construct validity, dimensionality, or factor structure.

The research was conducted in accordance with the principles of educational research ethics, particularly as the research participants were junior high school students aged between 12 - 15 years. Prior to data collection, the researcher first obtained research permission from the school and relevant institutions. This research was carried out after obtaining approval from the school and ethical/administrative authorisation from the relevant authority, reference number: [B/0386/UN34.16/PT.01.04/2026]. Because the participants were minors, the study was conducted with school permission and parental or guardian consent procedures coordinated through the participating schools. All participants were provided with an explanation of the research objectives, the test procedures, data confidentiality, the voluntary nature of their participation, and their right to withdraw from the study should they feel uncomfortable at any stage during the research process.

The confidentiality of participants' identities was safeguarded by not including students' names in the analysis and reporting of the research findings. The data collected was used solely for academic purposes and for the development of cognitive assessment instruments for Physical Education. Furthermore, the test results were not used to determine students' academic marks at school; consequently, student participation had no direct impact on formal academic assessment. The following is the research design for the development of the cognitive test in this study (Figure 1).



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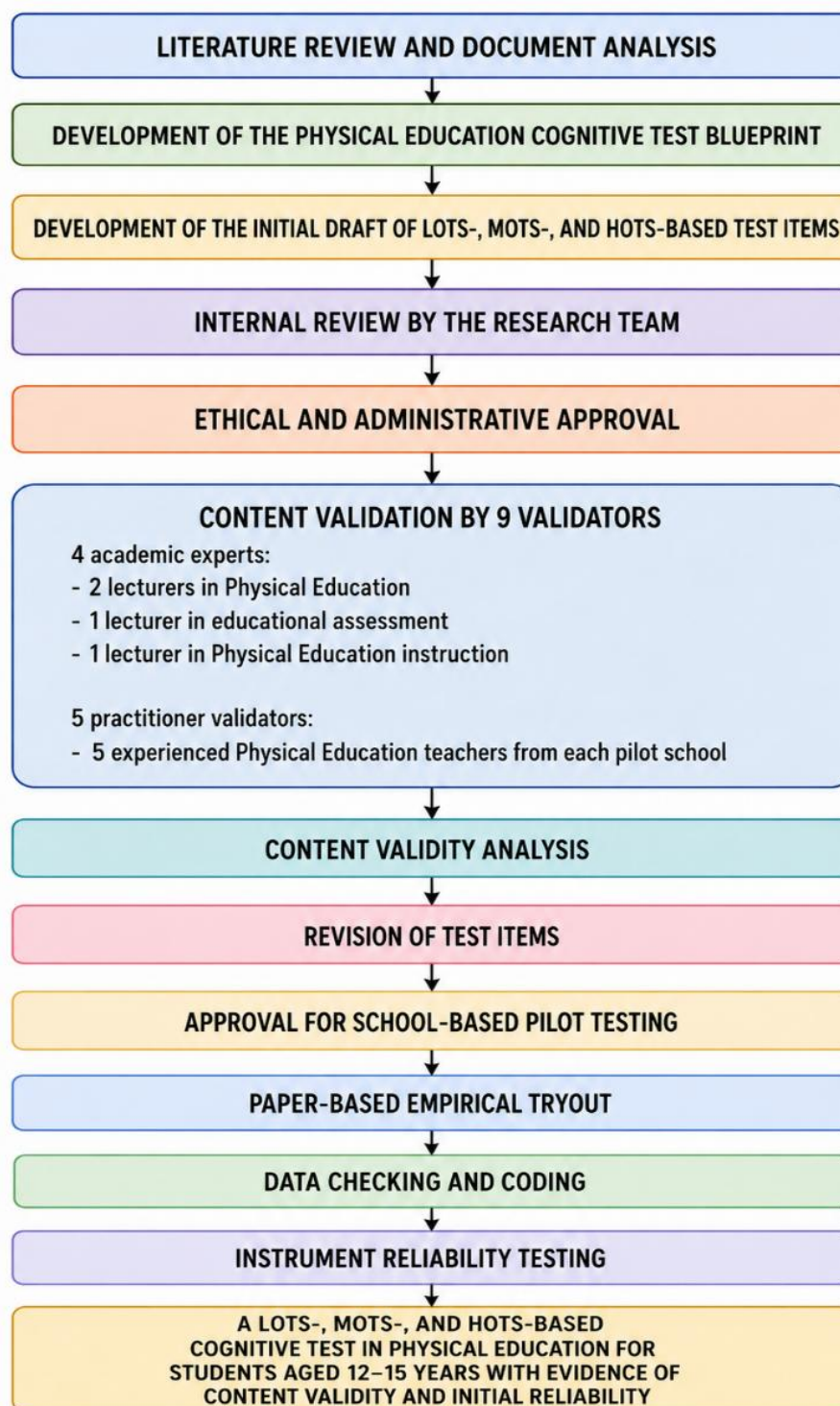


FIGURE 1. Research framework for the development of cognitive tests



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Study Participants

The participants in the empirical trial for this study were students in grades 7, 8 and 9 from five lower secondary schools in Pacitan Regency, East Java Province, Indonesia. The schools were selected using a purposive sampling method, based on their suitability for the research objectives, the characteristics of students within the target age range, and the schools' willingness to serve as trial sites for the assessment instruments. At the student level, participation was based on the principle of voluntary participation, meaning that students took part in the study of their own free will without coercion from the researchers, teachers or the school. All students were given an explanation of the general aims of the study, the test procedures, data confidentiality, and the fact that the test results would not be used to determine their academic marks.

The inclusion criteria for this study were that participants must be currently enrolled in grades 7, 8 and 9 at one of the study schools, be aged between 12 and 15 years, be taking Physical Education lessons at school, be willing to participate voluntarily, and complete the test in accordance with the study procedures. Exclusion criteria included students outside the target age range, those unwilling to take part in the study, those who did not return their answer sheets, those who provided incomplete answers, those who gave multiple answers to many items, or those whose answer sheets could not be clearly coded.

A total of 1,810 students were initially invited from the five participating schools. Of these, 722 students returned complete and codable answer sheets and were included in the final analysis. The final sample consisted of 436 male students and 286 female students. Based on grade level, 234 students were in Grade 7, 314 students were in Grade 8, and 174 students were in Grade 9. The distribution of participants across the five schools was relatively balanced, ranging from 141 to 148 students per school. A total of 1,088 students were not included in the final analysis because they either did not return the answer sheet or submitted incomplete or uncodable responses.



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TABLE 1. Characteristics of the final analysed sample

Characteristic	Category	n	%
Gender	Male	436	60.4
	Female	286	39.6
Grade	Grade 7	234	32.4
	Grade 8	314	43.5
	Grade 9	174	24.1
School	School 1	146	20.2
	School 2	141	19.5
	School 3	143	19.8
	School 4	144	19.9
	School 5	148	20.5

The content validity of the instrument involved nine validators, comprising four academic experts and five practitioner validators. The four academic experts included two lecturers specialising in Physical Education, one lecturer specialising in learning assessment, and one lecturer specialising in Physical Education pedagogy. The five practitioner validators were experienced Physical Education teachers from each of the pilot schools. The involvement of academic experts and practitioner validators aimed to ensure that the test items were not only conceptually and academically sound, but also aligned with the characteristics of the students, the learning context, and assessment practices in Physical Education at lower secondary schools.

Instrument Development

The development of the instrument began with a literature review and qualitative document analysis of journal articles, Physical Education textbooks, curriculum documents, and references on cognitive assessment. This stage was carried out to identify the scope of Physical Education content at lower secondary school level, the characteristics of cognitive development in students aged 12–15 years, and the principles of test design in line with learning objectives. Based on the results of this review, the instrument developed is designed to measure students' cognitive abilities in understanding concepts, rules, principles of movement, game



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strategies, safety in physical activity, physical fitness, and health-related content relevant to Physical Education.

The next stage is to draw up a test framework as the basis for item development. This framework includes the learning content or scope, question indicators, cognitive levels, question types, answer keys, and thinking categories comprising Lower Order Thinking Skills, Middle Order Thinking Skills and Higher Order Thinking Skills. Items are categorised into LOTS, MOTS and HOTS by referring to the framework of cognitive thinking skills, ranging from the ability to recall and understand, apply, to analyse, evaluate and make decisions within the context of Physical Education. LOTS are designed to measure understanding of basic concepts, MOTS to measure the application of concepts in learning situations or physical activities, whilst HOTS are designed to measure higher-order thinking skills in the context of games, physical activities, health and sports safety.

The test items are formulated as multiple-choice questions with four answer options: A, B, C and D. Each item has only one correct answer, whilst the other answer options serve as distractors. The drafting of the items takes into account clarity of wording, the appropriateness of the language for the developmental level of lower secondary school students, the accuracy of Physical Education concepts, alignment with the indicators, and the logical consistency of the answer options. Furthermore, the development of test items also takes into account a balance between questions that assess basic knowledge, conceptual understanding, the application of concepts, and analytical skills, so that the test is not solely focused on rote learning but also reflects students' thinking skills in Physical Education.

Before the instrument was given to expert validators for analysis, the initial draft of the test was first reviewed by the research team. This internal review was carried out to ensure consistency between the content, indicators, LOTS–MOTS–HOTS levels, answer keys and answer options. Items with unclear wording, potentially ambiguous answer keys or ineffective distractors were revised before proceeding to the content validation stage. The outcome of this instrument development stage is a preliminary draft of a LOTS, MOTS and HOTS-based Physical Education cognitive test, ready to be assessed by expert validators and empirically tested on students.



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Data Collection Procedure

Data collection was carried out once the initial draft of the Physical Education cognitive test instrument had been finalised, based on a framework containing the subject matter, item indicators, answer keys, and the thinking levels of Lower Order Thinking Skills (LOTS), Middle Order Thinking Skills (MOTS) and Higher Order Thinking Skills (HOTS). The initial draft of the instrument, which had been prepared by the research team, was first reviewed internally to ensure consistency between the indicators, learning content, cognitive levels, question formats and answer options. Once the draft instrument was deemed ready, the next stage involved content validation by expert validators before the instrument was used in an empirical pilot study with students.

Content validation involved nine validators, comprising four academic experts and five practitioner validators. The academic experts consisted of two lecturers specialising in Physical Education, one lecturer specialising in learning evaluation or assessment, and one lecturer specialising in curriculum/learning. Meanwhile, the practitioner validators comprised five experienced Physical Education teachers from each of the schools where the instrument was piloted. The validators were asked to assess several key aspects, namely the alignment of items with Physical Education content, alignment with question indicators, the accuracy of LOTS, MOTS and HOTS levels, clarity of wording, the appropriateness of the language for lower secondary school students, the accuracy of the answer key, the quality of answer options or distractors, and the suitability of items for use in Physical Education cognitive tests.

Content validity was assessed using a 1 - 4 scale, in addition to providing quantitative scores, the validators were also given the opportunity to provide comments, notes or suggestions for improvement regarding each test item. Qualitative feedback from the validators was used to refine the wording of the items, adjust the level of difficulty, clarify answer options, amend answer keys that were potentially ambiguous, and review the appropriateness of the LOTS, MOTS and HOTS levels. Items that received low scores or substantial comments from the validators were revised before proceeding to the pilot testing stage with students.

Before the empirical pilot test was conducted, the ethical and administrative permission letter was distributed to the five participating schools one week prior to data collection. Student



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participation was carried out after written parental or guardian consent had been obtained and after approval had been granted by the school authorities. Once the content validation and item revision processes had been completed, the instrument was pilot-tested on junior secondary school students aged 12–15 from five schools. The pilot test was conducted as a paper-based test, as the computerised system for administering adaptive tests had not yet been implemented at this stage of the research. Students completed the test individually under the supervision of researchers and/or Physical Education teachers in accordance with the established procedures. Before the test began, the students were given a brief explanation of the general objectives of the activity, how to answer the questions, the time allowed, and the importance of answering each item according to their own understanding.

Once the pilot test had been completed, all answer sheets were collected and checked for completeness. Answer sheets that were not returned, were not fully completed, contained duplicate answers for many items, or could not be clearly coded were excluded from the analysis. Data meeting the criteria were then coded with a score of 1 for correct answers and 0 for incorrect answers. Consequently, the data analysed comprised complete student responses suitable for testing the initial reliability of the instrument using the KR-20 method based on students' dichotomous response data.

Data Analysis

Content validity data were analysed using Aiken's V to determine the level of agreement amongst the validators regarding the appropriateness of each test item (Figure 2). The validators' assessments were made on a scale of 1–4, where 1 = strongly disagree, 2 = disagree, 3 = agree, and 4 = strongly agree. The Aiken's V analysis was based on the assessments of nine validators across eight aspects: content appropriateness, indicator appropriateness, accuracy of LOTS, MOTS and HOTS levels, clarity of wording, linguistic appropriateness, accuracy of answer keys, quality of distractors, and item appropriateness. The Aiken's V coefficient was calculated using Microsoft Excel by applying the content validity formula to the validators' scores for each assessment aspect. Items with Aiken's V scores that met the acceptance criteria



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were retained, whilst those receiving low scores or substantial comments from the validators were revised before being used in the empirical trial (Lewis. R. Aiken, 1985; Wedi et al., 2025).

$$V \text{ Aiken's: } \frac{\sum S}{n(c-1)}$$

S : r – lo
Lo : lowest rating score
C : highest rating score
r : the score given by the assessor

Figure 2. Aiken V Formula

Then, the students' response data were analysed to determine the internal reliability of the instrument using the Kuder-Richardson 20 (KR-20) formula. Prior to analysis, all answer sheets were checked for completeness; thereafter, students' responses were coded dichotomously, with a score of 1 for a correct answer and a score of 0 for an incorrect answer. The KR-20 was used because the instrument took the form of a multiple-choice test with a correct-incorrect scoring system (Arriah & Romba, 2023). The KR-20 coefficient was calculated using Microsoft Excel based on the number of items, the sum of item-level p and q values, and the variance of the total test scores. The reliability values obtained were used to assess the preliminary internal consistency of the LOTS, MOTS and HOTS based Physical Education cognitive tests. Thus, the data analysis in this study yielded two main pieces of evidence: evidence of content validity based on expert and practitioner validator evaluation and evidence of preliminary internal reliability based on students' responses.

Results

Physical Education Cognitive Test

The Cognitive Test for Physical Education developed in this study consists of 115 multiple-choice items. Each item is designed to measure students' understanding of Physical Education material at the junior high school level, taking into account various levels of Lower-Order Thinking Skills (LOTS), Middle-Order Thinking Skills (MOTS), and Higher-Order Thinking Skills (HOTS). Of the total items, there are 47 LOTS items, 35 MOTS items, and 33



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HOTS items. Thus, the item composition indicates that this test focuses not only on the ability to remember and understand basic concepts but also on the ability to apply, analyze, and make decisions within the context of Physical Education learning.

The test material was developed based on seven main areas of Physical Education learning. The first covers large ball games, namely basic soccer techniques, volleyball techniques, and basketball techniques. The second covers small ball games, consisting of basic badminton techniques and table tennis techniques. The third covers athletics, including sprinting, long jump, and discus throwing. The fourth covers floor gymnastics, specifically basic floor gymnastics techniques. The fifth item covers physical fitness components. The sixth item covers the traditional Indonesian martial art, pencak silat. Meanwhile, the seventh item covers healthy lifestyles and injury prevention.

The distribution of items by cognitive level shows that the LOTS has the largest number of items, at 47, or approximately 40.87% of the total questions. LOTS items are used to measure students' basic abilities to remember, recognize, and understand important concepts in Physical Education. Meanwhile, the MOTS consists of 35 items, or approximately 30.43%, and aims to measure students' ability to apply concepts to learning situations, games, physical activities, or health. HOTS, consisting of 33 items, or approximately 28.70%, is designed to measure higher-order thinking skills, such as analyzing game situations, evaluating actions, and making appropriate decisions in the context of physical activity.

Content Validity Test

The cognitive test for Physical Education, developed in draft form and reviewed by researchers, then proceeded to the validation phase. The following are the results of Table 2, which represent the validation tests conducted by four lecturers and five physical education teachers.



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TABLE 2. Validity test results for cognitive tests

Aspects	ΣS	n (c - 1)	Aiken V
Material suitability	24	27	0,889
Indicator suitability	23	27	0,852
LOTS, MOTS, and HOTS level accuracy	24	27	0,889
Editorial clarity	24	27	0,889
Language suitability	23	27	0,852
Answer key accuracy	23	27	0,852
Distractor quality	24	27	0,889
Item suitability	23	27	0,852
Overall validity value			0,870

Based on the Aiken's V analysis (table 2), all aspects of content validity received scores ranging from 0.852 to 0.889. The highest scores were obtained for the appropriateness of the material, the appropriateness of the LOTS, MOTS, and HOTS levels, the clarity of wording, and the quality of the distractors, each with a score of 0.889. These results indicate that the validator assessed the test items as appropriate to the scope of the Physical Education material, accurately grouped the levels of thinking, used clear wording, and had distractor options suitable for use in multiple-choice tests.

The aspects of appropriateness of the indicators, appropriateness of the language, appropriateness of the answer key, and appropriateness of the items received an Aiken's V score of 0.852. This score indicates that the test items met the criteria for appropriateness of content, although several items could be refined based on qualitative feedback from the validator. Improvements can be made primarily in the clarity of the indicators, the use of language appropriate to the characteristics of students aged 12–15, the accuracy of the answer key, and the appropriateness of the items before wider use.

Reliability Test

Reliability testing was conducted to determine the internal consistency of the Physical Education cognitive test based on the responses of 722 students. Reliability analysis used the Kuder-Richardson 20 Formula (KR-20) because the test items were multiple-choice with a



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dichotomous score, namely correct = 1 and incorrect = 0. The results of the reliability test are presented in Table 3 below.

TABLE 3. Internal consistency reliability of the Physical Education cognitive test based on KR-20 analysis

Cognitive Test	n	k	k-1	Σpq	Total Score Variance	KR-20
LOTS	722	47	46	11.178	25.445	0.573
MOTS	722	35	34	8.535	17.084	0.515
HOTS	722	33	32	8.126	19.831	0.609
Overall	722	115	114	27.839	87.391	0.687

Based on the KR-20 analysis (table 3), the LOTS item group obtained a reliability coefficient of 0.573, the MOTS item group obtained a coefficient of 0.515, and the HOTS item group obtained a coefficient of 0.609. These findings indicate that the internal consistency of the item groups varied across cognitive levels. The HOTS item group showed the highest KR-20 coefficient, followed by the LOTS and MOTS item groups. However, these subscale reliability values should be interpreted cautiously because they indicate limited-to-moderate preliminary internal consistency rather than strong reliability.

Overall, the Physical Education cognitive test obtained a KR-20 coefficient of 0.687. This result suggests that the overall test demonstrated limited-to-moderate preliminary internal consistency at the initial development stage. Although the coefficient indicates that the instrument has initial reliability evidence, it should not yet be interpreted as a fully established psychometric instrument. Further item refinement and broader psychometric testing are still required, including item difficulty analysis, item discrimination analysis, distractor analysis, and more advanced validation procedures in subsequent studies.

Discussion

This study produced a Physical Education cognitive test based on LOTS, MOTS and HOTS for students aged 12-15, comprising a total of 115 multiple-choice items. The test comprises 47 LOTS items, 35 MOTS items and 33 HOTS items, meaning that this instrument not only focuses on recall and comprehension but also measures application, analysis,



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evaluation and decision-making within the context of Physical Education. The content validity results show that the Aiken's V values for each aspect range from 0.852 to 0.889, whilst the KR-20 reliability results indicate a value of 0.687 for all items overall. Consequently, this test can be considered to have good content validity (Susiono et al., 2024; Putro et al., 2025) and but only limited-to-moderate preliminary evidence of internal consistency based on students' responses (Frese et al., 2025).

Development of cognitive tests in Physical Education is crucial because learning in Physical Education does not merely focus on motor skills, physical fitness and motor performance, but also encompasses an understanding of concepts, rules of the game, strategies, safety, health and decision-making. This emphasis is in line with the view that Physical Education needs to support students' learning outcomes comprehensively, encompassing cognitive, affective and psychomotor aspects on an ongoing basis (Wulandari et al., 2023; Hariadi et al., 2025). Furthermore, Physical Education can serve as a means of developing students' learning outcomes holistically, however teachers still need to maximise the integration of analytical thinking skills into movement-based learning (Blegur et al., 2023). Therefore, the cognitive tests developed in this study play an important role as a tool to help teachers gain a more objective picture of students' conceptual understanding, rather than merely their practical skills.

Distribution of test items, comprising 47 LOTS, 35 MOTS and 33 HOTS, indicates that this instrument has a tiered cognitive structure. LOTS items form the basis for assessing students' ability to recognise, recall and understand basic concepts in Physical Education, whilst MOTS items assess students' ability to apply these concepts in learning situations or physical activities (Ritonga et al., 2021). Meanwhile, HOTS items provide scope for assessing higher-order thinking skills, such as analysing game situations, evaluating actions and making the right decisions (Pisriwati et al., 2024). This tiered structure is educationally relevant because cognitive assessment in Physical Education should not stop at factual recall, but should also capture students' ability to apply concepts and make decisions in movement, game, health and safety contexts. In this respect, MOTS serves as an intermediate level between basic conceptual understanding and more complex analytical or evaluative thinking (Blegur et al., 2023).



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Scope of the examination material, comprising seven main areas, indicates that this instrument was developed to represent the Physical Education curriculum at lower secondary school level in a fairly comprehensive manner. The material covers team ball games, small-group ball games, athletics, floor exercises, physical fitness, pencak silat, as well as healthy lifestyles and injury prevention. This scope is important because the cognitive domain in Physical Education relates not only to knowledge of movement techniques, but also to an understanding of health, safety, strategy, and the context of physical activity (Gilib et al., 2022; Milošević et al., 2026). Previous research has shown that the knowledge aspect of physical literacy encompasses an understanding of how to move, movement assessment, health, fitness, the benefits of physical activity, and safety considerations (Pastor-Cisneros et al., 2026). Therefore, the scope of the material in this test can be considered relevant to the need for a more holistic assessment of cognitive skills in Physical Education.

The content validity results showed that all assessment aspects obtained high Aiken's V values, namely between 0.852 and 0.889, with an overall value of 0.870. This finding indicates that the validators judged the test items appropriately in terms of material, indicators, LOTS–MOTS–HOTS levels, wording, language, answer keys, distractors, and item feasibility. These results are in line with previous research that used Aiken's V to assess the content validity of disaster preparedness instruments in the context of Physical Education in Junior High Schools (Saryono et al., 2025), with expert assessment using a four-point scale and all statements obtained values above 0.87. These results are also in line with other research that shows that Aiken's V values in producing problem-solving measurements in the range of 0.817–0.884 can be used as evidence of content validity based on expert panel assessments (Kania et al., 2024). Thus, the Aiken's V findings in this study indicate that the items were considered relevant and appropriate from a content perspective, although this evidence should not be interpreted as evidence of construct validity.

Compared with previous research instruments, this study broadens the direction of instrument development in Physical Education. The focus of this study is not on attitudes, learning processes or physical literacy in general, but specifically on a cognitive test organised according to LOTS, MOTS and HOTS for students aged 12-15 years. The instrument



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development of the previous study, the Physical Education Learning Process Questionnaire for Physical Education students, demonstrated that instruments developed in the context of Physical Education need to consider the specific characteristics of the field, as Physical Education has a combination of theoretical and practical contexts (Tannoubi et al., 2022). Furthermore, the *Physical Education Knowledge Questionnaire-Spain* to assessed Physical Education knowledge in children aged 6–12 and stated that knowledge instruments aligned with the national curriculum are important for measuring cognitive domains in physical literacy (Pastor-Cisneros et al., 2026). In contrast to these studies, the present study uses a tiered cognitive framework based on LOTS, MOTS and HOTS, thereby contributing to the development of Physical Education cognitive assessment for lower secondary school students. This finding also supports the findings of Ridha et al., (2025) who stated that physical literacy research in Indonesia still tends to be fragmented, focused on skills, and requires validated and contextually relevant assessment instruments.

The reliability results show that the KR-20 coefficients were 0.573 for LOTS, 0.515 for MOTS, 0.609 for HOTS, and 0.687 for the overall test. These coefficients indicate limited-to-moderate preliminary internal consistency rather than strong or fully adequate reliability. Therefore, the reliability results should be interpreted cautiously, especially at the subscale level. The MOTS group had the lowest coefficient, indicating the need for item refinement at this cognitive level. This result is understandable because subscale reliability is often influenced by the number of items, material variation, heterogeneity of student abilities, and the uniformity of the construct being measured. As a comparison, Ospankulov et al. (2023) study on the development of a multiple-choice Physical Education cognitive ability test with a correct score = 1 and incorrect = 0, then obtained a KR-20 coefficient of 0.85 in a trial of 120 students (Ospankulov et al., 2023). Other studies also show that dichotomous data in multiple-choice tests can be analyzed using the KR-20 to produce a reliability coefficient (Arriah & Romba, 2023). The lower KR-20 coefficients in the present study may be explained by the broader scope of the instrument, the inclusion of multiple Physical Education content areas, the use of three cognitive levels, and variation in item difficulty across a large sample of students. Accordingly, the reliability evidence should be viewed as preliminary and should be



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strengthened through item revision, difficulty analysis, discrimination analysis, distractor analysis, and further empirical trials.

Implications of this research are important for Physical Education teachers, schools, and the development of cognitive assessments at the junior high school level. For teachers, this test can serve as an initial reference for developing more systematic, tiered cognitive assessments that focus beyond memorization. For schools, this instrument can support a more structured Physical Education question bank based on material and level of thinking. For assessment development, the results of this study can serve as an initial basis for strengthening item quality before entering further analysis stages, such as difficulty level, discriminatory power, item calibration, or the development of a computer-based testing system. This relevance aligns with previous research on development instruments in sports, which require a step-by-step process, starting with literature review, expert discussions, content validity, item analysis, and broader reliability and validity testing (Nam et al., 2022; Putro et al., 2025). Thus, this research should be positioned as an early stage in the development of a Physical Education cognitive item bank, rather than as the final validation of a fully established assessment instrument.

This study has several limitations that require attention. First, the test was still administered as a paper-based test, thus not yet describing a computer-based assessment system or adaptive testing that would be the direction of long-term development. Second, the validity evidence in this study still focuses on content validity using Aiken's V, thus not including construct validity or validity based on modern measurement models. Third, the reported reliability is still based on initial internal reliability using the KR-20, while more in-depth item quality such as difficulty level, discrimination power, distractor effectiveness, and IRT calibration has not been described. In addition, this study did not conduct exploratory factor analysis, confirmatory factor analysis, Rasch modelling or item response theory analysis; therefore, the dimensionality and construct structure of the test remain unconfirmed. Therefore, further research is recommended to conduct trials in a wider area, analyse item characteristics using classical test theory and item response theory, and develop a computer-based assessment system or computerized adaptive testing.



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Conclusion

This study produced a Physical Education cognitive test based on lower-, middle-, and higher-order thinking skills for students aged 12-15 years. The developed instrument consisted of 115 multiple-choice items, with a composition of 47 LOTS items, 35 MOTS items, and 33 HOTS items. Coverage materials include large ball games, small ball games, athletics, floor gymnastics, physical fitness, pencak silat, as well as healthy lifestyles and injury prevention. The results of content validity showed that the Aiken's V value for all aspects was in the range of 0.852-0.889, with an overall value of 0.870, indicating that the items had strong evidence of content relevance based on expert and practitioner judgement. The reliability results showed an overall KR-20 value of 0.687, indicating limited-to-moderate preliminary internal consistency. Thus, this test may serve as a preliminary basis for further item refinement, Physical Education cognitive item-bank development, and broader psychometric validation.

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Attachment

Contents

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MATERIAL	NO	QUESTION	ANSWER CHOICES				ANSWER	LEVEL
			A	B	C	D		
Material 1	1	The basic technique used to pass the ball to a teammate in soccer is called...	Dribbling	Passing	Shooting	Heading	B	LOTS
	2	Kicking the ball hard toward the opponent's goal with the aim of scoring is called...	Passing	Heading	Shooting	Dribbling	C	LOTS
	3	The body part used to perform the header technique in soccer is...	Feet	Heading	Hands	Chest	B	LOTS
	4	The basic technique in volleyball used to start the game is called...	Smashing	Blocking	Passing	Service	D	LOTS
	5	Hitting the ball hard and breaking through the opponent's defense sharply in volleyball is called...	Service	Smash	Blocking	Passing	B	LOTS
	6	Which of the following is a defensive technique to block an opponent's attack at the net in volleyball?	Smashing	Overhead Pass	Blocking	Service	C	LOTS
	7	The movement of passing a volleyball with your hands positioned below or parallel to your chest is called...	Overhead Pass	Underhand Pass	Breaking	Service	B	LOTS
	8	The movement of passing a volleyball using your fingers above your head is called...	Underhead Pass	Overhand Pass	Blocking	Lay-up	B	LOTS
	9	Dribbling the ball by bouncing it on the floor in basketball is called...	Passing	Shooting	Dribbling	Blocking	C	LOTS

10	Shooting the ball directly toward the hoop to score in basketball is called...	Passing	Shooting	Dribbling	Lay-up	B	LOTS
11	Passing the ball using your hands in basketball is called...	Passing	Dribbling	Shooting	Shooting	A	LOTS
12	If a soccer player wants to deliver a long-range high pass to an attacker, the most common technique is...	Dribbling	Heading	Passing	Stand still	C	MOTS
13	When the ball is high in the air and the player's position does not allow for control with the feet, the best action is...	Shooting	Heading	Dribbling	Blocking	B	MOTS
14	In volleyball, after receiving a serve from an opponent, the most appropriate technique to secure the ball before passing is...	Underhead Pass	Overhead Pass	Dribbling	Blocking	A	MOTS
15	A volleyball setter (passer) wants to deliver a precise pass in front of the net so that a teammate can smash. The best technique to use is...	Underhead Pass	Overhand Pass	Serving	Because it's done with your back to the basket	B	MOTS
16	Why is the lay-up considered to have a high accuracy rate for scoring points in basketball?	Because it's done from a distance	Because the shooting position is as close to the ring as possible	Because the ball is bounced on the floor first	To commit a foul	B	MOTS
17	Basketball players dribble the ball while walking or running. The main goal of this dribbling combination is...	To waste time in the match	To approach the opponent's ring or find space	To score directly from the middle of the court	Positioning in place	B	MOTS
18	A soccer player sees the opposing goalkeeper standing too far from the goal. The player is outside the penalty box. Analyze the best tactical action for the player:	Dribbling close to the goalkeeper	Executing a high shot (chipping) directly at the goal	Making a short backward pass	Relying solely on the goalkeeper to attack	B	HOTS
19	In a soccer match, team A employs a total defense strategy. To penetrate this tight defense, what basic technique variations would be most effective for team B to incorporate?	Continuous individual dribbling in the middle	Quick short pass combined with long-range shooting	Making a score in your own area	Executing a counter smash without touching the ball	B	HOTS

	20	Your volleyball team is constantly receiving powerful smashes from tall opposing attackers. What basic techniques should be evaluated and refined in their net defense strategy?	Improving service accuracy	Strengthening the dam (blocking) simultaneously	Making an aggressive overhead pass	Underhand pass forces the opponent to commit a foul	B	HOTS
	21	When receiving powerful smashes from opponents aimed low into the corner, volleyball players struggle with overhead passes. Analyze why underhand passes are more effective in this situation!	Underhead Pass has a lower range and is stable enough to absorb hard balls	Underhand Pass makes the ball dead	Making an underhand pass strengthens your arm muscles	Executing a dead pass towards the opponent's feet	A	HOTS
	22	A basketball player is dribbling quickly during a fast break. In front of the basket, he or she faces only one opposing defender. What finishing technique is most effective and dynamic to avoid the opponent's block?	Shooting 3-pointers from a distance	Lay-up Shot utilizes running momentum	Making a backward dribble	Executing a lay-up calmly	B	HOTS
	23	With 3 seconds remaining in the basketball game, team A is trailing by 2 points. A player from team A gains possession of the ball outside the opponent's defensive line (3-point area). What basic engineering decision carries a high risk but is the only chance to win?	Dribbling around the court	Executing a short pass to a teammate	Making a speculative shot (3-point shot) directly to the hoop	Heading	C	HOTS

MATERIAL	NO	QUESTION	ANSWER CHOICES				ANSWER	LEVEL
			A	B	C	D		
Material 2	24	The basic badminton technique used to start a match or game is called...	Smash	Drop Shot	Serve	Clear	C	LOTS
	25	The object or ball hit in badminton is known as...	Shuttlecock	Ping-Pong Ball	Ballspin	Shot	A	LOTS
	26	The bat used in badminton is commonly called...	Racket	Betting	Stick	Glove	A	LOTS
	27	An offensive stroke delivered with full force so that the shuttlecock dives sharply into the opponent's area in badminton is...	Serve	Clear	Drop shot	Smash	D	LOTS
	28	A badminton stroke that directs the shuttlecock as if to smash, but the shuttlecock lands gently near the opponent's net is called...	Drop shot	Clear	Long serve	Smash	A	LOTS
	29	The bat used in table tennis is commonly called...	Racket	Betting	Stick	Glove	B	LOTS

30	A table tennis hitting technique in which the palm of the hand holding the racket faces forward is called a...	Backhand	Front Hand	Spin	Smash	B	LOTS
31	A table tennis stroke executed when the ball is to the left of the body (for right-handed players) is called...	Forehand	Back Shot	Underhand serve	Clear	B	LOTS
32	When your opponent is positioned too far forward near the net in badminton, the most appropriate tactical action is to hit the shuttlecock with a...	Slim drop shot	Clearly backward	Direct smash	Short serve	B	MOTS
33	What is the main goal of a badminton player in executing a sharp, powerful smash?	Prolongs the match and tires the opponent	Returning the shuttlecock in a horizontal direction to maintain a stable position	Destroying the opponent's defense to win the point quickly	Execute a subtle feint to land the shuttlecock near the net	C	MOTS
34	When playing badminton, you receive the shuttlecock in front of the net from a relatively low position. What is the safest basic stroke to prevent the shuttlecock from hitting the net?	Does a jumping smash	Pushing the shuttlecock with a soft drop shot or lifting it high (clear)	Returning serve	Hit the shuttlecock as hard as possible straight towards the net	B	MOTS
35	A table tennis player finds the opponent's ball bouncing high off the left side of his body. If he were right-handed, the most appropriate technique would be...	Powerful forehand shot	Backhand shot from the chest to the outside	Long serve technique	High clear shot	B	MOTS
36	In table tennis, what is the fundamental difference in ball contact between forehand and backhand strokes?	Forehand shot using the side of the racket, backhand shot using the handle	Forehand hits the front of the racket (palm-aligned), backhand hits the back of the racket	Forehand only for blocking the ball, backhand specifically for hitting hard	Forehand hit the ball before it bounces, backhand hit it after it bounces	B	MOTS

			(back-aligned)				
37	Which is the most logical tactical sequence for a table tennis player to win a point from a defensive position?	Serve -> Surrender - > Win	Backhand Block -> Placement of the ball at a difficult angle -> Execute an attack with a hard forehand when the ball is in play	Brain-fire smash from under the table -> Continuous serve	Use the clear technique repeatedly until your opponent gets bored	B	MOTS
38	In a badminton doubles rally, the opposing team is continually returning the shuttlecock with low, soaring clears in the middle of your court. What tactical analysis would be the best decision for you to make?	Does a slow drop shot into the middle of your own net	Execute a hard, diving smash between the opponent's stances to break up a rally	Letting the shuttlecock fall in the hope that the line judge will call it out	Execute an emergency short serve	B	HOTS
39	A badminton singles player finds himself physically exhausted midway through the second set, while his opponent is playing a fast-paced attack. Analyze what basic technique variations he should frequently employ to slow the tempo?	Does a continuous series of powerful smashes without stopping	Apply a high clear (lob) technique to the back line combined	Deliberately serving incorrectly to prevent a rally from progressing	Stand still in the middle of the court while holding the net	B	HOTS

			with a slow, thin net game				
40	If a badminton player has poor mastery of the basic short serve technique (the shuttlecock is too high above the net), what are the fatal tactical consequences for him in a high-level match?	The opponent will have difficulty returning the shuttlecock	This responsible serve will be immediately countered by the opponent with a fast smash to break the point	The match is automatically stopped and declared passive	The referee will immediately give a red card to the coach	B	HOTS
41	Analyze why a top table tennis player must master the rapid transition between forehand and backhand techniques in fast-paced rallies!	So the athlete can lose weight quickly during the match	Because the direction of the ball's arrival from the opponent cannot be predicted absolutely, it requires a betting position requirement	Because international rules require a change of strokes in each rally	To prevent the badminton racket grip from wearing out quickly	B	HOTS

	42	In table tennis, variations of short, thin, and spinning serves are frequently used. Analyze why this serving technique is considered tactically safer than a long, powerful straight serve!	Because long serves are prohibited by the World Table Tennis Federation	Short, spinning serves limit the opponent's opportunity to immediately execute a smash or aggressive attack from the first ball	Because short serves do not require eye concentration	To prevent the ping pong ball from breaking due to the hard impact of the table	B	HOTS
	43	In a singles table tennis match, player A notices that player B consistently struggles to return the ball in the back left corner of his table. Analyze the ball placement strategy that player A should prioritize!	Continues to hit the ball to the right in front of player B's net	Directing variations of deep backhand shots or sharp cross forehand towards the back left corner of player B's table	Stopping play and asking the judge to move the table	Execute a high smash into the air without any clear direction	B	HOTS

MATERIAL	NO	QUESTION	ANSWER CHOICES				ANSWER	LEVEL
			A	B	C	D		
Material 3	44	The correct sequence of three basic techniques for short-distance running is...	Run, start, finish	Start, run, finish	Start, finish, run	Run, finish, start	B	LOTS
	45	The type of start used by short-distance runners (sprinters) is...	Start in flight	Standing start	Crouch start	Seated start	C	LOTS
	46	The jumping movement that begins with a sprint to achieve the greatest possible distance is called...	High jump	Long jump	Triple jump	Pole vault	B	LOTS
	47	The first stage an athlete must perform in the long jump before taking the push is...	Floating	Start	Landing	Pushback	B	LOTS
	48	The first element that must be mastered in the shot put before performing the push is...	How to hold the shot put	Starting stance	Push-off	Follow-up movement	A	LOTS

49	The body position and preparation before the shot is pushed from the shoulder in the shot put are called...	Starting position	Push-off	Finish	Start run	A	LOTS
50	Why must a short-distance runner maximize their starting acceleration technique when the "ya" command or the sound of the gun sounds?	To avoid disqualification by the judges	To gain maximum initial momentum and speed	To allow for a relaxed run in the middle of the lane	To conserve energy until the finish line	B	MOTS
51	In short-distance running, what is the difference between body position during the running phase and the phase approaching the finish line?	When running, the body is upright, when the body finishes jumping	While running, the body leans forward; at the finish, the chest lands forward	When running, the body is bent, when finished, the body is upright	No difference in body position	B	MOTS
52	In the long jump, if an athlete executes a full-speed run but fails to execute a powerful push off the springboard, what is the impact?	The stall distance is very short because there is no upward thrust	The resulting change will be safer and smoother	Athletes will stay in the air longer	The committee will immediately issue a disqualification	A	MOTS
53	What is the primary function of the circular movement of both arms forward and upward during the long jump takeoff?	To maintain balance and avoid falling on the board	Helps provide upward lift (vertical velocity) during flight	To enhance aesthetic movements in the air	Preparing the feet for landing	B	MOTS
54	Why is the placement of the shot put against the jaw/neck so important in the starting position of the shot put?	To prevent the shot put from falling on the athlete's feet	To maintain the stability of the projectile and channel maximum propulsion energy	To deceive the opponent's eyes	Making it easier for the judges to see the weight of the shot put	B	MOTS

55	What is the fundamental mechanical difference between holding a shot put until it's pushed off and holding a ball to throw it?	The shot put is held with the entire palm, the ball only with the fingers	The projectile rests on the base of the fingers with the palm off the projectile, while throwing the ball, the hand is fully gripped	The shot put is held with two hands, the ball with one hand	No difference in grip	B	MOTS
56	Why is a forward-leaning body position during short-distance running and approaching the finish line so crucial for a sprinter?	To slow down the running speed gradually after the finish line	Helps combat wind resistance and accelerate the chest to touch the finish line first	To prevent the runner from falling backward	To keep the runner's eyes focused downward	B	HOTS
57	A short-distance runner (100m) makes the mistake of lifting his body too quickly (straight up) immediately after the "yes" command for the start. Analyze the tactical disadvantage this runner experiences!	The runner will be immediately disqualified by the judges	Loss of momentum, acceleration, and forward thrust due to wind resistance immediately increases	The shot put's stride becomes too long and uncontrolled	The runner will experience immediate thigh muscle cramps	B	HOTS

58	Analyze why the coordination between initial speed and the strength of the supporting leg during the takeoff is a key determinant of an athlete's jump distance in the long jump!	A high starting speed without a proper push-off will only cause the athlete to slip on the board	Push-off functions to convert horizontal velocity from initial velocity to vertical velocity during flight	A slow start actually results in a much stronger push-off	The landing is not affected by the start and take-off process	B	HOTS
59	In the long jump, an athlete lands well, but after landing, his buttocks or hands fall backward onto the sand. What is the legal measure of the athlete's jump distance?	The distance is measured from the point of the front foot	Distance is measured from the nearest body part to the take-off board (hand/buttock position behind)	The jump is immediately disqualified and does not count	The judges will measure from the center of the sandpit	B	HOTS
60	In the shot put, if an athlete predominantly "throws" the shot put from behind the shoulder (rather than pushing/pushing from the side of the neck), what evaluation will the judges give?	The push-off result remains valid because the shot put flies very far	The push-off result is considered invalid (failed) because it violates the basic principles of pushing and risks arm injury	Athletes earn additional points for creative movement variations	The judges will ask to repeat the take-off without any penalty	B	HOTS

	61	If a short shot put athlete is able to optimize his speed during the transition from starting position to takeoff, how will his takeoff distance compare to a taller athlete with slower movements?	Remain shorter because a tall posture always results in the longest distance	It can go further, because the explosive speed of the push-off provides a large propulsion force on the projectile in accordance with the principle of momentum	It's the same, because the weight of the shot put is different	A short athlete's take-off is automatically disqualified if it is too fast	B	HOTS
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MATERIAL	NO	QUESTION	ANSWER CHOICES				ANSWER	LEVEL
			A	B	C	D		
Material 4	62	The movement of leveling the body forward through the back of the body (nape, back, waist, and pelvis) is called...	Backward roll	Forward Roll	Backbend	Candle Pose	B	LOTS
	63	The first body part to touch the mat after the hands during a forward roll is...	Head roll	Nape of the Neck	Backward roll	Forehead Pose	B	LOTS
	64	The movement of leveling the body backward, while the body must remain rounded, is called...	Forward roll	Candle Pose	Backward roll	Candle Pose	C	LOTS
	65	The position of lying on your back and then raising both legs straight up while the waist is supported by both hands is called...	Kayang	Forward Roll	So that the body weight rests solely on the head	To avoid requiring abdominal muscle strength	D	LOTS
	66	Why must the body be rounded (chin touching the chest, knees bent to the chest) when performing a forward roll or a backward roll?	To make the movement appear to be completed more quickly	To facilitate smooth body rotation following the rotation	To push the legs forward	To reduce the weight on the shoulders	B	MOTS

67	What is the main purpose of placing both hands on the waist when performing the candle pose?	As a decorative aesthetic complement to the movement	To support and maintain a straight waist and leg position	Because the back supports the entire body weight when turning	To allow the kayang movement to be performed with the eyes closed	B	MOTS
68	Why is the flexibility of the back muscles the most dominant factor in success in a bridge?	Because without back flexibility, the hands won't be able to reach the mat to form the position	To allow the head to land first on the mattress	Forward rolls use the forehead, backward rolls use the crown of the head	Forward rolls involve a straight body position, while backward rolls involve a rounded body position	A	MOTS
69	The fundamental difference in the order in which body parts contact the mat between forward and backward rolls is...	Forward rolls start from the hips, backward rolls start from the nape of the neck	Forward rolls begin at the nape of the neck, back rolls begin at the hips/buttocks	The push-off is too strong at the start of the movement	The mat used is too soft and thick	B	MOTS

70	A student repeatedly attempts a forward roll, but always lands head-first, causing pain. Analyze what mistakes the student made!	Arm muscles are not strong enough to support the weight	Students should not bend their heads inward so that the forehead/crown hits the mattress, not the nape of the neck	The speed of the head swinging backward is too slow	The body position is too rounded from the start of the movement	B	HOTS
71	When performing a backward roll, a child consistently fails and falls back to the original squatting position. Upon observation, his hands did not push off the mat when his hips rose. Evaluate the root cause of this failure!	Lack of comfort in the ankles	Failure to push/push off both hands in sync and strongly when the mattress touches the shoulders	Andi takes his eyes off his toes	Andi's shoulders do not touch the mat evenly	B	HOTS
72	In a candle pose test, Andi was able to lift his legs straight up, but the position continued to sway violently and couldn't last for three seconds. Analyze the main factors that caused Andi to lose his balance!	Placing the mat slanted on the hall floor	Abdominal muscles are not contracted enough (not locked) and the elbows are positioned too wide on the mattress/not strong enough to support the waist	Both hands move too quickly, exceeding the flexibility of his back	Eyes are too focused on the ceiling	B	HOTS

	73	A gymnast attempted a backbend from a standing position. As his body began to fall backward, he suddenly lost control and fell to his knees. Analyze the mechanical errors that caused the gymnast's fall!	Head position is too bent in front of the chest	Knee joints are not bent forward to balance the shift in body weight when the back is thrown backward	Backbend	Candle Pose	B	HOTS
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MATERIAL	NO	QUESTION	ANSWER CHOICES				ANSWER	LEVEL
			A	B	C	D		
Material 5	74	The ability of a muscle or group of muscles to contract to generate tension in a student is called...	Flexibility	Agility	Strength	Speed	C	LOTS
	75	A person's ability to perform work or physical activity for a long period of time without experiencing excessive fatigue is called...	Speed	Endurance	Strength	Flexibility	B	LOTS
	76	The body's ability to change direction quickly and precisely without losing balance is the resolution of...	Agility	Flexibility	Speed	Strength	A	LOTS
	77	The distance that the body or limbs can cover in the shortest possible time is the definition of...	Endurance	Flexibility	Speed	Strength	C	LOTS
	78	The ability of joints and muscles to move through their maximum range of motion without causing injury is called...	Agility	Flexibility	Speed	Strength	B	LOTS

	79	Why does a cross-country runner require a much more dominant endurance component than a sprinter?	Because sprinters don't use any energy at all when running, the shuttle run emphasizes rapid changes in direction, while sprinting emphasizes changing positions in a straight line as quickly as possible.	Cross-country requires muscular and cardiovascular activity over a very long period of time on varied terrain.	Sprinting only requires knee flexibility.	Cross-country runners move at maximum speed at all times.	B	MOTS
	80	What are the fundamental differences in movement mechanics between agility training (shuttle runs) and speed training (sprints)?	The athlete will move with great agility.	Shuttle runs require no energy, while sprints are very draining.	Shuttle running only trains the abdominal muscles, while sprinting trains the back muscles.	Sprints are performed back and forth, while shuttle runs are performed in one direction.	A	MOTS
	81	If an athlete has excellent strength components but very poor flexibility, what obstacles will this pose to their movement efficiency?	Dynamic stretching lowers body temperature, causing muscles to stiffen.	The body's range of motion is limited and muscles are more susceptible to strains.	The athlete's cardiovascular endurance will automatically increase significantly.	Athletes will not be able to perform a complete muscle contraction.	B	MOTS

82	Analyze how dynamic stretching affects the body's flexibility components before performing core exercises!	The relationship between strength and cardiovascular endurance.	Stretching increases muscle elasticity and expands joint range of motion, allowing the body to move at its maximum capacity.	Stretching serves to exhaust energy before the match.	Stretching reduces oxygen supply to the muscles.	B	MOTS
83	Sprinters often experience hamstring injuries mid-race. After evaluation, he was found to have very strong but stiff thigh muscles. Analyze the relationship between the fitness components that the runner neglected!	The student has good cardiovascular endurance but very weak arm muscles.	The balance between high muscle strength and a lack of flexibility training.	The relationship between agility and nervous reaction speed.	The effect of abdominal muscle endurance on the thigh muscles.	B	HOTS
84	A student was able to do 50 push-ups in one minute without stopping, but immediately collapsed after being asked to run 2.4 km. Analyze the student's fitness condition based on this case!	Agility helps the athlete run straight, while strength helps conserve energy.	Students have extraordinary arm muscle endurance but poor cardiorespiratory endurance.	The student experienced abdominal muscle fatigue due to incorrect movement.	The student's agility component interferes with their respiratory system.	B	HOTS

	85	In a badminton match, a player must chase a ball in front of the net, then suddenly jump back to hit a smash. Analyze the integrative role of the agility and strength components in this movement scenario!	Agility will increase because the body has greater momentum when turning.	Agility plays a role in quickly changing body positions on the court, while muscle tremors and arm strength generate explosive power for smashes.	Agility slows down the opponent's movement, while strength increases rest duration.	These two components work separately and do not affect each other.	B	HOTS
	86	Evaluate what happens to a person's agility performance if their body fat composition increases drastically!	Flexibility	Increased body fat increases the load (inertia) that must be moved, thus slowing acceleration and deceleration when changing direction.	Body fat only affects the shoulder joint flexibility component.	The central nervous system will send signals to speed up movement.	B	HOTS

MATERIAL	NO	QUESTION	ANSWER CHOICES				ANSWER	LEVEL
			A	B	C	D		
Material 6	87	The position of the feet to strengthen the body's position so that it is not easily reached during defense or attack is called...	Block	'Horse' Stance	Punches	Kick	B	LOTS
	88	An attack technique performed using a clenched, bare hand as the primary tool is called...	Kick	Punch	'Horse' Stance	Punch	D	LOTS
	89	A physical attack in pencak silat that exploits the weakness of the feet or legs as an offensive tool is called...	Block	Punch	Kicks	Evasion	C	LOTS
	90	An attempt at defensive contact made by directly engaging the opponent's attack to redirect it is called...	Punch	Circular Kick	Evasion	Evasion	B	LOTS

91	A kick in pencak silat that travels straight forward, striking the base of the toes or the sole of the foot is called...	T-Kick	T-Kick	Straight/Front Kick	Side kick	C	LOTS
92	A kick in which the body is positioned sideways and forms a "T" trajectory, striking the heel or the sharp outer edge of the foot is called...	Straight Kick	A solid stance provides a foundation for the action-reaction forces from the ground to be channeled into maximum punching power.	Short Kick	Arc kick	B	LOTS
93	Why is a strong and stable mid-stance so crucial to the effectiveness of a front punch in pencak silat?	Middle stance transfers all energy into the air	A straight punch travels straight to the chest, while a circular punch travels in an arc from the side of the body.	Middle Stance: Speeds Up the Blocking Duration	To scare the opponent and prevent them from approaching	B	MOTS
94	What is the most striking mechanical difference between the front (straight) punch technique and the circular punch technique?	Straight punches use a straight elbow, circular punches	An inside or outside block shifts the direction of the opponent's	Straight punches are for defense only, circular punches are for offense	Circular punch without using the fist	B	MOTS

			use the knee	linear attack.				
95	When launching a straight kick at your opponent's chest, which blocking technique is the most effective and safest for deflecting the attack?		Upper block uses one hand	Because the T-kick does not require single-legged balance.	Underhand block with one's own leg	Staring intently at the opponent's feet without moving	B	MOTS
96	Why is it recommended that a silat practitioner use a kicking technique rather than a straight kick when attempting a long-range attack that pushes the opponent's body?		Because the T-kick has mechanical thrust from the hip and heel joints, it can exert significant horizontal pressure	Incorporates a back stance to pull the face back, combined with alternating upper or inside blocks.	T-kick: Performed with one's back completely turned	To allow the athlete to sit directly on the mat	A	MOTS
97	In a match, your opponent often uses a strategy of consecutive straight punches to the face. Analyze which combination of statistical and dynamic defenses would be most effective for you to counter these attacks!		Using the middle stance statistics while closing the eyes	The fist position is not locked (stiff) upon impact, allowing the wrist joint to absorb the impact.	Executing a T-kick while jumping behind the referee	Standing on one leg (candle pose) in the corner of the mat	B	HOTS

98	A silat athlete complains of frequent wrist pain and sprains after striking his opponent's chest with a pendulum punch. Evaluate the technical errors the athlete is making!	Middle stance foot position is too wide	The supporting leg does not rotate outward, and the knee of the supporting leg is too straight, shifting the body's center of gravity away from the base of support.	Pendulum punch: The direction of the punch is too straight towards one's own stomach	The athlete strikes with an open palm	B	HOTS
99	When executing a circular kick (silat), the silat athlete often loses balance and falls over, even though the opponent doesn't block it. Analyze the root cause of this loss of balance!	The kicking foot is too straight up towards the ceiling	The side stance allows silat athletes to quickly run to the side of the mat.	The front guard punch is too close to the forehead	Pencak Silat belt tied too tightly around the waist	B	HOTS
100	Evaluate the tactical advantage of using a side stance combined with a T-kick against an aggressive, forward-moving opponent!	The side stance reduces the target area of the body facing the opponent, and the T-kick acts as a linear block that pushes the opponent back	Horse Stance	This combination forces the judge to award a foul to the opponent	Removing the function of the athlete's hands for the entire round	A	HOTS

MATERIAL	NO	QUESTION	ANSWER CHOICES				ANSWER	LEVEL
			A	B	C	D		
Material 7	101	Consuming foods that contain all the nutrients the body needs in the right amounts and proportions is called...	Eat as much as you can	Eat a balanced diet	Strict diet	Instant Diet	B	LOTS
	102	The nutrient that serves as the main source of energy for the human body to carry out daily activities is...	Vitamins	Minerals	Carbohydrates	Air	C	LOTS
	103	Light physical activity performed before starting core exercise with the aim of preparing the body is called...	Cooling Down	Warm-up	Core exercise	Contraction	B	LOTS
	104	The activity of gradually decreasing the intensity of movement after completing core exercise is called...	Warming Up	Stretching Statistics	Cooldown	Conditioning	C	LOTS
	105	Micronutrients that function to regulate metabolic processes and maintain endurance but do not produce energy are...	Fat	Protein	Carbohydrates	Vitamins and Minerals	D	LOTS
	106	The type of nutrient that functions as a building block for the growth and repair of damaged body tissue is...	Carbohydrates	Fat	Protein	Vitamins	C	LOTS
	107	An activity that helps the body recover from physical and mental fatigue after a day of activity is called...	Exercise	Recreation	Rest	Diet	C	LOTS
	108	What is the main function of fluids or air for our bodies during intense exercise?	As the main energy source	Regulates body temperature and replaces fluids lost through sweat	Strengthens bone structure	Increases running speed	B	LOTS
	109	Why must a balanced nutritional intake be adjusted to a person's daily physical activity level?	So that weight can be lost drastically without exercise	Energy needs vary from person to person depending on the calories burned during activity	So the body doesn't need any more rest time	Keeps the digestive system from working at night	B	MOTS

110	What is the fundamental difference between the physical impacts of warm-up and cool-down exercises on the body?	Warming up lowers body temperature, raises core temperature	Warm-up increases body temperature and heart rate, gradually cooling them down	Warming up is only for athletes, cooling down is for beginners	Warming up tightens joints and cools the heart	B	MOTS
111	If a person suddenly stops completely and sits cross-legged after running at high intensity without cooling down, what are the possible consequences for blood circulation?	Blood flow to the brain increases sharply	Pooling of blood in the legs can cause dizziness or muscle cramps	Leg muscles automatically become more flexible	Heart rate returns to normal sleeping position immediately	B	MOTS
112	Why is water much more recommended during exercise than soda or high-energy sugary drinks?	Water contains high calories for energy	Water makes the body feel warmer	Soft drinks can strengthen muscle structure	Water is quickly absorbed by the body for rehydration and relaxation without overloading the kidneys and pancreas with excess sugar	D	MOTS

113	A teenager often sleeps late (only getting 4 hours of sleep a night) and enjoys eating fast food. Even though he exercises diligently every afternoon, he still gains weight and often falls ill. Analyze why this happens!	The exercise is too light	Regarding a balanced lifestyle; exercise cannot compensate for the adverse effects of lack of rest and poor nutrition	The teenager drank too much water	Lack of sleep doubles the number of calories you eat during exercise	B	HOTS
114	Analyze why the order of injury prevention: Warm-up -> Core Exercise -> Cool-down, is considered a cycle of body mechanics that cannot change or eliminate any of them!	Because this sequence is a standard rule of the International Olympic Committee	Each phase has sequential physiological functions: increasing circulatory readiness, allowing the core to perform mechanical work, and accelerating the body's safe return to homeostasis.	If the burn is done early, the muscles will become too hot before the match	Changing the order of your meals will result in the loss of the nutritional content of your food	B	HOTS

	115	Why is consuming high-fiber foods (such as vegetables and fruit) an important part of a balanced, nutritious diet, even though fiber is indigestible and provides no calories?	Fiber functions as a substitute for carbohydrate energy	Fiber maintains digestive health, helps control blood sugar levels, and provides a feeling of fullness for longer, thus preventing overeating.	Fiber binds vitamins so they don't get excreted in the urine	Fiber helps speed up the process of warming up your muscles from within	B	HOTS
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