

Development of a J-SPORTED-Based Physical Education Learning Model to Enhance Critical Thinking Skills of Junior High School Students

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Abstract. Physical Education, Sports, and Health learning is still commonly directed toward mastering movement techniques and following teachers' instructions. Students have not been given enough opportunities to analyse game situations and determine suitable strategies. As a result, their critical thinking skills have not been developed optimally. This study was conducted to produce a J-Sported-based physical education learning model that was feasible, practical, and effective in improving junior high school students' critical thinking skills. A Research and Development method was applied using the ADDIE stages consisting of analysis, design, development, implementation, and evaluation. Product validation was conducted by three experts. The limited trial involved 12 students while the field trial involved 64 students who were divided into experimental and control groups. Data were collected using expert validation sheets, learning implementation observation sheets, teacher and student response questionnaires, and a critical thinking test. The data were analysed through feasibility percentages, descriptive statistics, normality tests, homogeneity tests, an independent samples t-test, and N-Gain analysis. The developed model obtained a feasibility score of 91.67 percent and was classified as highly feasible. Learning implementation reached 92.18 percent while user responses were classified as highly practical. The experimental group obtained an average N-Gain score of 0.71 whereas the control group obtained 0.34. A significant difference was found between the improvement of both groups with a p -value below 0.001. These findings indicate that the J-Sported model was feasible and practical to implement. It was also considered effective in improving students' interpretation, analysis, evaluation, inference, explanation, and self-regulation skills during physical education learning.

Keywords: critical thinking, J-Sported, learning model, physical education, junior high school students

1. Introduction

Physical Education, Sports, and Health (PJOK) constitutes a vital component of education, as it fosters not only movement skills and physical fitness but also students' knowledge, attitudes, social competencies, and sense of responsibility. Within PJOK instruction, sports-based games can effectively cultivate critical thinking skills—particularly when students are required to assess situations, devise strategies, make decisions, and evaluate the outcomes of their actions [1].

However, PJOK instruction remains frequently dominated by teacher-centered, command-based methods. Students often merely mimic demonstrated movements without sufficient opportunity to ask questions, explore alternative movements, identify the causes of errors, or understand the rationale behind the decisions made. Consequently, the learning process tends to be mechanical and fails to optimally develop higher-order thinking skills.

To address these issues, the J-Sported learning model was developed, integrating problem-based learning, inquiry, collaboration, tactical games, educational competition, and HOTS-based reflection. This model positions movement-related problems as the starting point of instruction; students then explore, formulate strategies in groups, test solutions through gameplay, and evaluate decisions through critical reflection [2].

J-Sported is implemented through six stages: introducing game objectives and problems; exploring movement in small groups; reinforcing tactical understanding through modified games; formulating and testing team solutions; conducting mini-tournaments; and engaging in critical reflection and HOTS-based assessment. Competition within this model serves not only to determine winners but also to foster teamwork, rapid decision-making, and the ability to refine strategies [3].

The novelty of J-Sported lies in the integration of these various learning approaches into a single, systematic, and operational framework. This model is expected to serve as a guide for teachers in developing critical thinking skills without compromising the core characteristics of Physical Education (PJOK)—namely, movement, play, social interaction, and direct experiential learning.

2. Method

Research Type and Design

This study employs the Research and Development method to create a J-Sported-based Physical Education (PJOK) learning model. The product was not merely conceptualized; its feasibility, practicality, and effectiveness were also tested through several stages. The development procedure followed the ADDIE model, comprising analysis, design, development, implementation, and evaluation. This model was selected because, while the stages proceed sequentially, revisions can still be made if shortcomings are identified [4].

Product testing was conducted in two phases. A one-group pretest-posttest design was used for the limited trial. Critical thinking skills were measured before and after the model was implemented with 12 students. This stage focused primarily on assessing the readability of the instructional materials and the feasibility of the model's procedural steps (syntax). Any obstacles encountered during the activities were also documented to inform revisions.

The primary effectiveness test utilized a quasi-experimental design—specifically, a pretest-posttest control group design. Existing classes were used without reassigning individual students. One class was designated as the experimental group and received instruction using the J-Sported model, while the other served as the control group, following the standard Physical Education instruction typically employed by the teacher.

The design for the effectiveness test is structured as follows.

Table 1 Effectiveness Test Design

Group	Pretest	Treatment	Posttest
Experimental	O ₁	J-Sported model	O ₂
Control	O ₃	Commonly used learning	O ₄

O₁ and O₃ represent measurements of critical thinking skills taken prior to instruction, while O₂ and O₄ represent measurements taken after instruction. The intervention was administered over six sessions focusing on large-ball games, with each session lasting two class periods. A control group was employed so that score changes would not be assessed solely based on pre- and post-intervention differences; these changes could also be compared against the progress of students receiving standard instruction. The proposal design indeed designates the limited trial and the extensive trial as two distinct testing phases. The extensive trial utilizes a quasi-experimental design to enable a comparison of the model's effectiveness across groups [5].

Research Setting and Timeline

The study was conducted at SMP HM Lirboyo Papar, Kediri Regency. The school was purposively selected because Physical Education (PJOK) instruction was already being conducted on a scheduled basis. A permanent PJOK teacher was available, and the school was

open to implementing a new instructional model. Another consideration was the availability of two parallel classes with relatively balanced student numbers. These conditions allowed for the administration of pre-tests and post-tests on the same schedule without significantly disrupting school activities.

The research spanned six months, from January to June 2026. A needs analysis was conducted in January, followed by the design phase in February. The initial product and instructional materials were developed and validated in March. A limited-scale trial was carried out in April, and a large-scale trial was conducted in May. Data processing and final evaluation were completed in June 2026.

This schedule was established to ensure that revisions were not rushed. Validated products underwent refinement before being implemented with students. Similarly, results from the limited-scale trial were reviewed before testing in larger classes took place. The research proposal outlined a development period of approximately six months, with each month dedicated to a specific stage, ranging from the needs analysis to the final evaluation.

Research Subjects

The research subjects were categorized according to the development stage. Product validation was conducted by three validators. The first validator was a lecturer with expertise in Physical Education (PJOK) instruction. The second validator possessed expertise in instructional design. The third validator was an expert in educational evaluation who assessed the critical thinking skills instrument. Each validator had over five years of academic and professional experience in their respective fields.

The limited trial involved 12 eighth-grade students. Students were selected based on a range of academic abilities: four from the high-ability group, four from the medium-ability group, and four from the low-ability group. This selection was made in consultation with the Physical Education teacher and based on prior academic records. A diverse composition was necessary to evaluate the clarity of instructions and the difficulty level of activities across students with varying characteristics.

The extensive trial involved 64 eighth-grade students. Thirty-two students were assigned to the experimental group, and 32 were assigned to the control group. Intact classes were used because student groupings had been established by the school at the beginning of the academic year. Group assignment was determined by a draw between two classes with relatively comparable characteristics. Initial ability equivalence was subsequently verified using pretest scores.

A Physical Education teacher was involved in conducting the instruction. Prior to implementation, the teacher received a briefing on the model's objectives and the J-Sported syntax. A teaching simulation was also conducted to ensure that each stage could be executed in accordance with the guidebook. Two observers were involved to assess the implementation of the model during the trial; using two observers helped minimize the risk of observational results being influenced by a single person's perspective.

Development Procedure

1. Analysis

The analysis phase was conducted to assess the state of instruction prior to the product's design. Data were gathered through observations of Physical Education (PJOK) activities and interviews with teachers. Instructional modules and assessment tools were also examined. Particular attention was paid to the methods typically employed. Student engagement and the types of questions posed during lessons were also observed.

The initial findings revealed that instruction largely consisted of brief explanations followed by demonstrations and repetitive practice. Opportunities to discuss movement-related issues were limited. Assessments focused primarily on technical accuracy, while students' ability to explain their reasoning or evaluate strategies was not specifically measured.

2. Design

During the design phase, the objectives and components of the J-Sported model were established. The instructional sequence was structured into six stages, comprising a game-based problem trigger and inquiry-based movement exploration. This was followed by the

reinforcement of tactical understanding. Team solutions were then formulated and tested through practice. A mini-tournament was held before the activity concluded with critical reflection and a Higher-Order Thinking Skills (HOTS) assessment [6].

The roles of the teacher and students were designed to differ from a full-command approach. The teacher acted as an activity facilitator and posed guiding questions. Answers were not provided immediately when errors occurred; instead, students were guided to examine the underlying causes and attempt alternative approaches deemed more appropriate.

3. Development

The initial draft was developed into a preliminary product. The guidebook included the model's rationale, objectives, and instructional syntax, as well as descriptions of the social system and principles of teacher reaction. Modified game formats were incorporated to ensure the model could be implemented even with limited school facilities.

Three validators evaluated the preliminary product using a five-point scale. In addition to assigning scores, the experts provided corrections and suggestions. Revisions were made to clarify terminology, the sequence of activities, and time allocations. Certain game instructions were simplified. The critical thinking assessment rubric was refined to ensure more consistent evaluation of the quality of student responses.

4. Implementation

An initial implementation was conducted with 12 students over the course of three sessions. During this stage, the clarity of instructions, time management, and the students' ability to follow each step were observed. A pre-test was administered before the activities began, and a post-test was given after the entire sequence was completed.

The results of the limited trial were used to carry out a second round of revisions. Adjustments focused primarily on the length of questions in the worksheets and the simplification of mini-tournament rules. The duration of group discussions was extended, as some students had not had sufficient time to explain the reasoning behind their strategy choices during the initial implementation.

5. Evaluation

Evaluation is conducted throughout the entire development process. Formative evaluation takes place following the analysis and design phases, as well as after validation and limited trials; it involves revising the content of the product or tool if it is not yet functioning effectively. Summative evaluation is carried out after the completion of extensive trials.

The quality of the model is determined based on three metrics. Feasibility is derived from validator assessments. Practicality is gauged by the feasibility of lesson implementation and the feedback from both teachers and students. Effectiveness is determined by changes in critical thinking skills and a comparison of results between the two groups. This evaluation approach aligns with the proposal design, which establishes validity, practicality, and effectiveness as the three pillars of product assessment.

Developed Product

The primary research output is a J-Sported-based Physical Education (PJOK) learning model. This model is operationalized through several resources designed for immediate use by teachers, comprising a model guidebook and an outline of the instructional steps (syntax). Teaching modules covering six sessions were also developed. Student worksheets are utilized to facilitate problem identification and the recording of exploration results. These worksheets provide space for students to document their initial strategies and testing outcomes, as well as to note any shortcomings in the decisions they made. Reflective questions are included at the end. Assessment tools consist of a model implementation rubric and a user response questionnaire. The critical thinking assessment instrument takes the form of open-ended questions based on game scenarios; these questions do not require the rote memorization of definitions. Instead, students are asked to analyze a problem, evaluate strategies, and justify the decisions they have chosen.

Research Instruments

An expert validation sheet was used to assess the content of the learning model and design, as well as the quality of the instruments. The aspects examined included the alignment of

objectives and content. The clarity of the model's syntax and its applicability were also evaluated. Each statement was assigned a score from 1 to 5, and a suggestions column was provided to gather data for revisions. An implementation observation sheet was used during both limited and extensive trials. Observations were based on the six stages of the J-Sported model. Scores were assigned based on the extent of activity implementation, ranging from non-execution to full execution. Field notes were recorded whenever obstacles arose that could not be adequately captured through numerical data alone.

The teacher response questionnaire consisted of 18 statements. Evaluations focused on the clarity of guidelines, ease of implementation, and time suitability. The model's benefits regarding student engagement were also assessed. The student response questionnaire contained 20 statements with a five-point response scale. The statements were drafted using simple language to ensure easy comprehension by junior high school students.

The critical thinking skills test comprised 12 open-ended questions. Each pair of questions was designed to measure a specific indicator. Responses were graded using a rubric with a score range of 0 to 4. A score of 0 was assigned if the answer was irrelevant to the problem, while a score of 4 was awarded if the decision was correct and supported by clear reasoning and evidence. Documentation was used to supplement process-related data. Collected documents included teaching modules, attendance lists, and activity photographs. Test scores and student worksheets were also retained as part of the research documentation. The instruments outlined in the proposal were categorized into qualitative and quantitative data. The critical thinking skills test served as the primary instrument, based on six indicators [7].

Data Collection Techniques

Observations were conducted during the needs analysis phase and when the model was implemented. In the initial stage, observations focused on recording learning patterns and student engagement levels. During implementation, observations centered on the execution of each step of the J-Sported model. Semi-structured interviews were conducted with Physical Education (PJOK) teachers. The information gathered concerned the teaching methods typically employed and the difficulties students faced. Teachers' readiness to implement HOTS-based instruction was also assessed. Questions were adapted based on the responses provided.

Questionnaires were distributed to validators and model users. Expert questionnaires were used to obtain data on feasibility, while teacher and student questionnaires were used to assess the product's practicality and acceptance. All questionnaires utilized a five-point Likert scale. Tests were administered twice during the large-scale trial: a pre-test before the intervention and a post-test after six sessions. Timing and instructions were standardized for both groups. Documentation was collected throughout the process, from the analysis stage to the final evaluation. Multiple techniques were employed to ensure that data regarding the process and the outcomes complemented each other.

Data Analysis Techniques

Validator comments and suggestions were analyzed through content categorization. Feedback with similar meanings was grouped together, and the results were used to refine the product. Observation and interview notes were also summarized based on initial instructional conditions, user needs, and implementation constraints.

Expert validation scores were calculated as a percentage using the following formula:

Table 2 Feasibility Percentage Categories

Percentage	Category
81–100%	Highly suitable
61–80%	Suitable
41–60%	Moderately suitable
21–40%	Less suitable
0–20%	Unsuitable

3. Results

Results of the J-Sported Model Development

Results of the Needs Analysis

The needs analysis phase was conducted through observations of Physical Education (PJOK) lessons in two Grade 8 classes. Interviews were also held with the Physical Education teacher. Additionally, the instructional materials and assessment methods used at the school were examined. These activities aimed to establish an overview of the instructional context prior to the development of the J-Sported model.

Observations revealed that instruction was still dominated by teacher explanations and movement demonstrations. Following the demonstrations, students were required to repeatedly mimic the same techniques. While this approach was deemed effective for introducing basic skills, opportunities for students to understand the rationale behind specific movements remained limited.

Questions posed during lessons were primarily recall-based; students were asked to state rules or reiterate techniques that had already been presented. There were few questions requiring students to evaluate game strategies, and reflection activities were not consistently implemented at the end of lessons. The results of the needs analysis are presented in the Table.

Table 3 Results of the Physical Education Learning Needs Analysis

No.	Aspects analyzed	Initial conditions observed:	Developmental needs
1	Learning patterns	Instruction remained teacher-centered	Instruction needs to assign a greater role to students
2	Methods used	Demonstrations and repetitive drills predominated	Problem-based activities and movement exploration are required
3	Student engagement	Some students were physically active but did not yet actively articulate their reasoning	Group discussions and prompting questions should be included
4	Application of HOTS	Analytical and evaluative questioning was limited	Tasks and activities need to focus on analysis and decision-making
5	Game situations	Games were primarily used as concluding exercises	Games should serve as a setting for testing strategies
6	Learning reflection	Reflection was not conducted in a structured manner	Critical reflection activities need to be incorporated into the instructional framework
7	Assessment	Assessment focused largely on movement skills	Assessment methods for critical thinking skills need to be developed
8	Learning resources	Sports facilities were available but limited in number	The model must be flexible and allow for the use of modified equipment

These results indicate that physical activities have actually been proceeding quite well, and students have become accustomed to participating in games. The main issue does not lie in a lack of movement-based activities; rather, there has been insufficient provision of opportunities to transform movement experiences into a thinking process.

Interview Results with the Physical Education Teacher

A semi-structured interview was conducted with the Physical Education (PE) teacher. The interview revealed that the command method remains a frequent choice because it is considered easier to implement. Managing large class sizes is a primary consideration; this method allows students to be guided within a relatively short timeframe [8].

The teacher noted that while problem-based learning has been used, it has not yet been implemented consistently. Key challenges lie in time management and the formulation of questions. During discussion activities, students sometimes take too long to determine their answers, thereby reducing the time available for practical movement.

Another difficulty arises in assessing critical thinking skills. The teacher lacks a specific rubric to evaluate the reasoning behind students' choice of strategies. Assessing movement

outcomes is easier because the indicators can be observed directly. There is a need for a simple assessment tool that allows for the evaluation of students' thinking skills without making the lesson feel overly burdensome.

It is considered essential for any new learning model to feature clear steps. Activities should also continue to incorporate games. The teacher prefers to avoid models that consume excessive classroom time, as the fundamental nature of PE instruction must be preserved. Based on this, the J-Sported model was designed to include brief discussions directly linked to movement-based experimentation.

Observations on Initial Learning Conditions

Observations were conducted over two sessions. The first session covered basic basketball techniques, while the second focused on soccer. Students demonstrated a high level of physical engagement; however, cognitive engagement was not uniform across the group. Of the 32 students observed, only 13 (40.63%) actively answered the teacher's questions, while 19 tended to wait for instructions. When asked to explain why a game strategy failed, only 9 students (28.13%) provided appropriate reasons.

Student discussions focused primarily on assigning positions rather than deeply analyzing the rationale behind those choices. Whenever the game faltered, the teacher immediately provided corrections; students were rarely involved in identifying for themselves which aspects needed adjustment. These conditions highlight the need for a model that integrates physical activity with cognitive processes. The analytical process need not be separated from the game itself; indeed, issues arising during play can serve as valuable learning opportunities.

Initial Status of Students' Critical Thinking Skills

A diagnostic test was administered to the two classes participating in the large-scale trial, involving a total of 64 students. The test consisted of open-ended questions based on game scenarios, with a maximum possible score of 100.

The mean initial proficiency score was 54.92. Scores ranged from a low of 38 to a high of 72. Eight students (12.50%) fell into the high-proficiency category, while 24 students (37.50%) were in the medium category. The remaining 32 students (50%) were in the low category.

Interpretation skills appeared stronger than other indicators; most students were able to comprehend the presented problems. However, the reasoning provided was not always supported by evidence from the game scenarios. The lowest scores were observed in the evaluation and self-regulation indicators.

When asked to assess unsuccessful strategies, students tended simply to state that the strategy was incorrect, without explaining the specific aspect that caused the failure. Proposed improvements were also often vague, consisting of general statements such as the need for better teamwork or improved gameplay.

These initial findings align with the research focus on enhancing critical thinking skills. The study measures these skills through interpretation, analysis, and evaluation, while also incorporating indicators for inference, explanation, and self-regulation.

The Need for a New Instructional Model

Observations and interviews indicate a need for a model that preserves the core character of Physical Education (PJOK). Physical activity must remain the primary component of instruction; however, students also need to be presented with problems to understand before executing movements.

The required model must assist teachers in managing the discussion process efficiently within a short timeframe. Instructional materials should include guiding questions, after which students are directed to test potential solutions through gameplay. This approach prevents discussions from becoming overly lengthy while maintaining a direct link to physical activity [9].

Flexibility is another key requirement. The model must be adaptable to settings with limited facilities, allowing for adjustments to the number of players and the size of the playing area. Game rules also need to be tailored to the specific subject matter and the students' circumstances.

Based on these considerations, J-Sported was developed by integrating contextual problems with movement exploration. It incorporates collaboration and tactical gameplay, while the learning process is complemented by educational competition and critical reflection. These elements were previously defined as the model's operational foundation in the research proposal.

Design Phase Results: The J-Sported Model Structure

The output of the design phase is a model structure comprising a rationale and objectives. The instructional syntax was developed alongside the social system and principles of reaction. Support systems and assessment methods were subsequently incorporated to enable the model's implementation in actual instructional settings.

The J-Sported model is designed to utilize game situations as a source of problems. Students are not immediately provided with a single "correct" solution; instead, they are encouraged to experiment with various movement alternatives. The outcomes are then compared, allowing decisions to be made based on experience.

This model is not intended to replace all forms of Physical Education instruction. It is best suited for subject matter involving tactical situations. Large- and small-ball games are appropriate choices, as they frequently present challenges related to positioning, spatial awareness, and decision-making [10]. The components of the J-Sported model are presented in the table.

Table 4 Components of the J-Sported Learning Model

Component	Design outcomes
Rationale	Game-based activities serve as a means to develop movement skills and critical thinking
Objectives	Skills in analyzing situations, as well as selecting and evaluating strategies, are enhanced through Physical Education (PJOK) instruction
Syntax	Six-stage learning process, ranging from problem-posing prompts to critical reflection
Social system	Interaction is fostered through group work, strategy discussions, and gameplay
Teacher's role	The teacher acts as a facilitator and poses guiding questions
Student's role	Students observe problems, experiment with movements, and formulate decisions
Principles of reaction	Mistakes are not immediately corrected but are instead used as opportunities for questioning and improvement
Support system	Includes a guidebook, teaching modules, student worksheets (LKPD), and assessment tools
Instructional effects	Critical thinking skills and tactical understanding
Nurturant effects	Cooperation, responsibility, and sportsmanship

The Six-Stage J-Sported Syntax

The J-Sported syntax is structured into six stages [11]; The first stage involves introducing objectives and presenting a game-based problem. Learning objectives are briefly outlined, followed by the presentation of a problem through a small-sided game or demonstration. Students are asked to identify aspects that are not yet functioning effectively.

The second stage consists of inquiry-based movement exploration. Students are divided into small groups to experiment with various movement alternatives. The teacher poses questions to ensure students do not merely mimic their peers' answers.

The third stage focuses on reinforcing tactical understanding. Modified games are used to examine the relationship between movement and game outcomes. Students are guided to read the positioning of both teammates and opponents.

The fourth stage involves designing team solutions and practical testing. Strategies are formulated based on the exploration phase, and roles are assigned within the groups. These strategies are then tested through gameplay.

The fifth stage comprises a mini-tournament and performance observation. A competitive environment is created using simplified rules. Game outcomes are evaluated based not only on the score but also on the processes of collaboration and strategy implementation.

Produced Outputs

The initial output is a 48-page guidebook for the J-Sported model. The book outlines the model's rationale and theoretical basis, while also explaining its objectives and instructional steps (syntax). Examples of game setups and guiding questions are also provided. Six instructional modules were developed for large-ball game activities, designed to cover six sessions. Each session includes learning objectives, game-related challenges, and exploration activities. Process-based assessment and reflection components are also included.

Student worksheets were developed in a concise format, keeping the content brief for practical use on the playing field. Students are required to record key challenges and their chosen strategies, as well as document experimental results and the rationale behind any adjustments made. The assessment tools consist of an implementation observation sheet and a response questionnaire. A critical thinking test comprising 12 open-ended questions was created, accompanied by a scoring rubric ranging from 0 to 4 points per answer.

Expert Validation Results

1. Subject Matter Expert Validation

Subject matter validation was conducted to assess the model's alignment with Physical Education (PJOK) learning objectives. The game content and conceptual accuracy were also evaluated. The subject matter expert awarded a score of 111 out of a maximum of 120, resulting in a feasibility rating of 92.50 percent. High marks were given for the alignment of activities with the nature of Physical Education instruction. The game scenarios were considered closely relevant to students' experiences, and movement activities remained the primary component of the lesson. Revisions were requested regarding the explanation of the term "J-Sported." The connection between the model's name and its syntax needed to be clarified more explicitly. Additionally, it was suggested that certain game rules be simplified to facilitate easier implementation in the field.

2. Instructional Expert Validation

Instructional validation focused on the clarity of the lesson flow and the coherence between objectives and activities. The social system and principles of reaction were also evaluated. A score of 109 out of a maximum of 120 was achieved, resulting in a feasibility rating of 90.83 percent. The syntax was deemed logically structured, and the progression from problem presentation to exploration and reflection was considered practical to implement. However, the time allocated for the discussion phase was considered excessive, and the phrasing of some guiding questions was found to be overly complex. In response to this feedback, the duration of the initial discussion was reduced, and questions were simplified to focus on one or two key points per activity. The explanation of the teacher's role was also clarified to ensure the lesson did not revert to a traditional lecture-based format.

3. Evaluation Expert Validation

The evaluation expert assessed the test blueprint and the alignment of critical thinking indicators. The scoring rubric and the wording of the questions were also reviewed. A score of 110 out of a maximum of 120 was awarded, resulting in a feasibility percentage of 91.67%. The alignment of the questions with the game scenarios was rated positively. The questions did not merely require "correct" or "incorrect" answers; students were asked to provide reasons. However, the distinction between score 2 and score 3 in the rubric lacked sufficient clarity. The rubric was subsequently revised. For score 2, the answer was defined as including a decision, but the reasoning lacked support from information provided in the problem. For score 3, the reasoning was appropriate, though the explanation was incomplete. A score of 4 was assigned if the decision, reasoning, and evidence were fully presented. The results of the expert validation are presented in the table.

Table 5 Expert Validation Results for the J-Sported Model

No.	Validator	Maximum score	Score obtained	Percentage	Category
1	Physical Education (PJOK) Subject Matter Expert	120	111	92,50%	Highly worthwhile
2	Instructional Expert	120	109	90,83%	Highly worthwhile
3	Evaluation Expert	120	110	91,67%	Highly worthwhile
	Average	120	110	91,67%	Highly worthwhile

The average validation result was 91.67 percent; consequently, the initial product was classified as highly suitable. Nevertheless, the product underwent further revisions, as several suggestions were deemed important for smooth implementation.

Validator Comments and Product Revisions

The validators' suggestions did not all pertain to errors in content; most of the feedback aimed to improve the product's usability. Revisions were carried out prior to the limited trial. The most significant revisions were made to the guidebook and the teaching module. The section outlining the instructional steps (syntax) was made more concise, and the teacher's instructions were separated from the student activities. These changes were implemented to prevent the pages from appearing overly cluttered during use.

Table 6 Validator Comments and Product Revisions

No.	Product components	Validator's notes	Revisions made
1	Model description	The meaning of the name "J-Sported" has not been clearly explained	Operational definitions and key model characteristics were added
2	Learning syntax	The exploration and tactical reinforcement stages appear to overlap	Objectives and activities for both stages were differentiated
3	Time allocation	Group discussions were considered too lengthy	Discussion time was shortened to 5–7 minutes
4	Trigger questions	Some questions use complex phrasing	Sentences were simplified and focused on a single issue
5	Game rules	There are too many rules for junior high school students	Core rules were retained, while supplementary rules were removed
6	Student worksheet	The space provided for answers is too limited	Answer space was enlarged and the table format clarified
7	Assessment rubric	The distinction between scores of 2 and 3 is not easily discernible	Score descriptions were detailed
8	Support system	Insufficient alternative tools have been provided	Options for modification tools and field dimensions were added
9	Reflection	There are too many reflection questions	Questions were selected down to three core items
10	Guidebook language	Some terms seem overly theoretical	Terminology was simplified and briefly explained

Product Feasibility Summary

Following initial revisions, each component of the product was re-examined. A summary was compiled based on expert evaluations of the five main products; the results are presented in the table. The guidebook received a score of 92.08 percent, indicating that the model's rationale and components were deemed adequate. The assessment tools achieved the highest score at 92.50 percent, a result attributed to the alignment between the rubrics and the designed learning activities. The student worksheet received the lowest score at 90.83 percent; although it remained in the "highly feasible" category, certain sections required simplification. Consequently, the worksheets were reformatted to span two pages per session to avoid encroaching on time allocated for physical activities.

Table 7 Summary of J-Sported Product Feasibility

No.	Evaluated products	Feasibility percentage	Category
1	J-Sported model guidebook	92,08%	Highly worthwhile
2	Teaching module	91,25%	Highly worthwhile
3	Student worksheets	90,83%	Highly worthwhile
4	Learning assessment tools	92,50%	Highly worthwhile
5	Critical thinking skills instrument	91,69%	Highly worthwhile
	Average	91,67%	Highly worthwhile

Revised Product

Following the revision, the J-Sported guidebook consists of five sections. The first section outlines the rationale and objectives. The second section explains the model's characteristics and components. A six-stage procedural framework is presented in the third section. The fourth section contains implementation guidelines. The final section includes assessment tools and alternative game modifications. The instructional module was also improved. Trigger questions were placed prior to the exploration activities. A section for team decision-making was added to the student worksheet. The reflection stage was streamlined while still incorporating reasoning, evidence, and plans for improvement. The revised product is considered to have met the three initial criteria. Its content aligns with Physical Education (PJOK) instruction, and the procedures are clear. The provided instruments correspond to critical thinking indicators. The product is now ready for a limited trial to assess its initial practicality in a real-world learning environment.

Limited Trial Results

A limited trial was conducted with 12 eighth-grade students over three sessions. This stage aimed to determine whether the J-Sported syntax could be implemented under actual classroom conditions. The clarity of instructions and time management were also evaluated. The lessons were conducted by a Physical Education teacher, while the implementation of activities was assessed by two observers. During the first session, some students still waited for direct instructions from the teacher. This tendency was evident when game-based problems were presented; students did not immediately engage in discussion but instead tended to ask what specific movements they should perform. Once the guiding questions were simplified, the exploration activities proceeded more smoothly.

The model's implementation improved from the first session to the third. Initially, the implementation rate was 84.38 percent. This figure rose to 89.58 percent in the second session and reached 93.75 percent in the third. The average implementation rate for the limited trial was 89.24 percent, placing it in the "very good" category. The problem-triggering and mini-tournament stages achieved the highest scores; these activities were understood more quickly because students were directly confronted with game situations. Lower scores were observed during the movement exploration phase. Some students were still attempting to find the specific answers they believed the teacher considered correct, rather than immediately testing alternative strategies. Consequently, the teacher's role was adjusted to focus on asking brief questions without revealing the solutions.

Table 8 Implementation of the Limited Trial

J-Sported Phase	Meeting 1	Meeting 2	Meeting 3	Average
Game-based problem trigger	87,50%	91,67%	95,83%	91,67%
Inquiry-based movement exploration	81,25%	87,50%	91,67%	86,81%
Reinforcement of tactical understanding	83,33%	89,58%	93,75%	88,89%
Solution design and practical testing	81,25%	87,50%	93,75%	87,50%
Mini-tournament	87,50%	91,67%	95,83%	91,67%
Critical reflection and HOTS assessment	85,42%	89,58%	91,67%	88,89%
Average	84,38%	89,58%	93,75%	89,24%

Teacher and Student Activities

Teacher activity was assessed based on the ability to introduce the problem and organize groups. The use of guiding questions and the management of the tournament were also evaluated. The average teacher activity score reached 90.28 percent, while student activity stood at 87.85 percent. This difference indicates that the teacher's implementation was quite consistent. Among the students, however, there was still some hesitation in articulating their reasoning. Some group members were more dominant, while others simply went along with decisions that had already been made.

By the third meeting, a system of role allocation was implemented. Each group included a strategy recorder and a game observer, and a specific student was designated to present the discussion results. This approach fostered more balanced participation, ensuring that group decisions were not determined solely by the most active students.

Teacher and Student Responses During the Limited Trial

Questionnaires were administered after the completion of three sessions. The teacher gave a score of 82 out of a maximum of 90, resulting in a response rate of 91.11 percent. The response rate from the 12 students reached 88.75 percent. The teacher assessed that the instructional steps (syntax) were understandable and well-aligned with the nature of Physical Education (PJOK). Game-based activities were allocated a significant amount of time. It was noted that the questions in the student worksheets (LKPD) needed to be more concise, as some students required considerable time for writing. Students gave the highest ratings regarding the engaging nature of the games. Lower ratings were observed regarding the ease of completing reflection sheets; students found it easier to provide answers verbally than to write them out at length.

Table 9 User Responses During the Limited Trial

Respondent	Aspects evaluated	Percentage	Category
Teacher	Clarity of procedures	93,33%	Very practical
Teacher	Ease of implementation	88,89%	Very practical
Teacher	Alignment with Physical Education (PJOK)	93,33%	Very practical
Teacher	Time efficiency	88,89%	Very practical
	Average teacher response	91,11%	Very practical
Student	Activity engagement	92,50%	Very practical
Student	Ease of following steps	87,92%	Very practical
Student	Opportunities for discussion	90,00%	Very practical
Student	Ease of reflection	84,58%	Very practical
	Average student response	88,75%	Very practical

Revisions Following the Limited Trial

Several improvements were made prior to the extensive trial. The number of questions on the worksheet was reduced from five to three core items. Written responses were no longer required to be in paragraph form; instead, students were permitted to briefly note the key decision and the underlying reasoning. The initial discussion time was limited to five minutes, while the reflection period was set at seven minutes. Role assignments were added to the guidebook to ensure every group member had a task. Tournament rules were also simplified and presented in a concise table. Adjustments were also made to the observation sheet. Score descriptions were defined more operationally to minimize discrepancies between the two observers' assessments. These changes were implemented during the extensive trial phase.

Implementation of the Large-Scale Trial

The large-scale trial involved 64 eighth-grade students. Thirty-two students were assigned to the experimental group, while the other 32 served as the control group. Both groups received instruction on large-ball games over the course of six sessions. The J-Sported model was implemented with the experimental group, whereas the control group followed the school's standard instructional method. The instructional content and duration were identical for both groups. The same teacher instructed both classes, ensuring that the primary difference in treatment lay in the structure of the learning activities. In the experimental group, game-related problems were presented at the beginning of the session; students then engaged in exploration and strategy testing, concluding the lesson with critical reflection. In the control group, technical explanations and demonstrations were provided first, followed by progressive practice and, subsequently, game play.

Implementation during the Extensive Field Trial

Model implementation was observed across all sessions. The average score reached 92.18 percent. The mini-tournament stage achieved the highest score at 94.53 percent, while the lowest score—89.84 percent—was recorded for the critical reflection stage. Table 8: Implementation of J-Sported during the Extensive Field Trial. The reflection stage received the lowest score not because the activity was omitted, but because available time was sometimes reduced when the game ran longer than expected. Additionally, some students required assistance to move beyond simply stating whether they had succeeded or failed.

Table 10: Implementation of J-Sported during the Extensive Field Trial

Learning stage	Implementation percentage	Category
Game-based problem triggers	92,97%	Excellent
Inquiry-based movement exploration	91,41%	Excellent
Reinforcement of tactical understanding	92,19%	Excellent
Solution design and practical testing	92,11%	Excellent
Mini-tournaments and performance observation	94,53%	Excellent
Critical reflection and HOTS assessment	89,84%	Excellent
Average	92,18%	Excellent

Teacher and Student Responses During the Large-Scale Trial

Teacher response reached 93.33 percent. Teachers considered the model reasonably easy to use once the time allocation was clarified. Student activities were also perceived as more focused, as each group had specific problems and tasks to resolve. Student response reached 92.03 percent. Most students found the learning process more engaging because the strategies they devised could be tested immediately. They also felt there were greater opportunities to express their opinions compared to previous learning experiences. Results regarding implementation and user feedback indicate that the model was successfully applied. Its practicality was evident not only from the teachers' assessments; students were also able to follow every stage without encountering significant obstacles.

Table 11 Teacher and Student Responses in the Large-Scale Field Test

Respondent	Aspect	Percentage	Category
Teacher	Clarity of the guidebook	94,44%	Very practical
Teacher	Ease of implementation	91,11%	Very practical
Teacher	Alignment with PJOK objectives	95,56%	Very practical
Teacher	Time efficiency	92,22%	Very practical
	Average teacher response	93,33%	Very practical
Student	Engagement level of the lesson	94,38%	Very practical
Student	Clarity of activity steps	91,25%	Very practical
	Opportunities for collaboration	93,13%	Very practical
Student	Opportunities to devise strategies	92,50%	Very practical
Student	Ease of reflection	88,91%	Very practical
	Average student response	92,03%	Very practical

Effectiveness Test Results

Descriptive Statistics for Critical Thinking Skills

Pretests and posttests were administered to both groups. The maximum test score was set at 100. The results of the descriptive analysis are presented in the table. The mean pretest score for the experimental group was 53.09, while the control group obtained a mean of 53.25. The difference between the two scores was only 0.16 points, indicating that initial ability levels were relatively balanced. Following instruction, the mean score for the experimental group rose to 86.22. The control group also showed an increase, reaching 68.97. The experimental group recorded an increase of 33.13 points, whereas the control group saw an increase of 15.72 points. The range of posttest scores for the experimental group also shifted; the lowest score reached 74. In contrast, the lowest score in the control group remained at 57. This difference provides an initial indication that J-Sported yields a greater improvement.

Table 12 Descriptive Statistics for Critical Thinking Skills

Group	Measurement	N	Minimum	Maximum	Mean	Standard deviation
Eksperimen	Pretest	32	39	69	53,09	8,54
Eksperimen	Posttest	32	74	95	86,22	4,94
Kontrol	Pretest	32	38	68	53,25	6,21
Kontrol	Posttest	32	57	77	68,97	5,57

Normality Test Results

The normality test was conducted using the Shapiro–Wilk test. The test was applied to the pretest and posttest data as well as the N-Gain. The results are presented in the table. All significance values were above 0.05; therefore, the data were determined to be normally distributed. Consequently, parametric analysis could be employed.

Table 13 Shapiro-Wilk Normality Test Results

Data	Group	Statistic	Sig. Note	Data
Pretest	Eksperimen	0,964	0,358	Normal
Posttest	Eksperimen	0,974	0,604	Normal
Pretest	Kontrol	0,991	0,994	Normal
Posttest	Kontrol	0,956	0,207	Normal
N-Gain	Eksperimen	0,980	0,789	Normal
N-Gain	Kontrol	0,975	0,634	Normal

Homogeneity Test Results

The equality of variances was examined using Levene's test. The test results are presented in the table. The significance values for all data were greater than 0.05. The variances of the experimental and control groups were determined to be homogeneous. The requirements for using the independent samples t-test were met.

Table 14 Homogeneity Test Results

Data yang diuji	Levene Statistic	Sig.	Information
Pretest	3,790	0,056	Homogen
Posttest	0,505	0,480	Homogen
N-Gain	0,458	0,501	Homogen

Results of the Initial Ability Difference Test

Differences in pretest scores were analyzed to ensure there was no significant difference in the initial abilities of the two groups. A t-value of -0.084 was obtained, with a significance level of 0.934. The significance value of 0.934 exceeds 0.05; thus, no difference in initial ability was found between the experimental and control groups. This condition allows for a comparison of post-treatment results on a more balanced basis.

Table 15 Results of Pretest Difference Test

Comparison	Mean difference	t	df	Sig. (2-tailed)	Decision
Eksperimen–kontrol	$-0,16$	$-0,084$	62	0,934	Not significantly different

Results of Change Analysis within Each Group

Changes in pretest and posttest scores were analyzed using a paired-samples t-test. The results indicate that both groups experienced a significant improvement. An improvement was also observed in the control group. This is understandable, as Physical Education (PJOK) instruction was still provided over the course of six sessions. However, the magnitude of the increase was lower than that of the experimental group.

Table 16 Paired-Samples t-Test Results

Group	Pretest	Posttest	Difference	t	df	Sig.
Eksperimen	53,09	86,22	33,13	30,149	31	<0,001
Kontrol	53,25	68,97	15,72	23,536	31	<0,001

Hypothesis Test Results

The main hypothesis was tested by comparing the post-test scores and N-Gain values of the two groups. The results of the independent samples t-test are presented in the table. The obtained significance value was less than 0.001. This value is below the 0.05 threshold. The null hypothesis was rejected. Thus, the improvement in critical thinking skills in the group using J-Sported was found to be significantly higher than that of the control group.

Table 17 Hypothesis Test Results

Data	Experimental mean	Control mean	t	df	Sig. Decision	Data
Posttest	86,22	68,97	13,099	62	<0,001	Significantly different
N-Gain	0,71	0,34	19,867	62	<0,001	Significantly different

N-Gain Analysis Results

The N-Gain value was calculated to assess the quality of the improvement achieved. The analysis results are presented in the table. The experimental group obtained an N-Gain of 0.71, placing it in the high category. The control group obtained a score of 0.34, placing it in the medium category. The difference in N-Gain between the two groups was 0.37. In the experimental group, 19 students (59.38%) fell into the high improvement category, while 13 students (40.62%) fell into the medium category. No students were found to be in the low improvement category. In the control group, no students fell into the high category. A total of 20 students (62.50%) were in the medium category, while 12 students (37.50%) remained in the low category.

Table 18 N-Gain Analysis Results

Group	Average N-Gain	Standard deviation	Minimum	Maximum	Category
Eksperimen	0,71	0,07	0,55	0,87	High
Kontrol	0,34	0,08	0,17	0,51	Medium

Table 19 Distribution of N-Gain Categories

Category	Experimental	Percentage	Control	Percentage
High	19	59.38%	0	0.00%
Medium	13	40.62%	20	62.50%
Low	0	0.00%	12	37.50%
Total	32	100%	32	100%

Magnitude of the Model's Effect

The magnitude of the effect was calculated using Cohen's d based on post-test scores. The obtained value was 3.27. Based on effect size criteria, this value falls into the "very large" category. These results indicate that the observed difference is not merely statistically significant; the magnitude of the difference between the two groups is also substantial in practical terms. However, this large value must be interpreted within the context of the study, given that the intervention was implemented across two classes within the same school.

Improvement Based on Critical Thinking Indicators

Critical thinking skills were analyzed based on six indicators. Scores for each indicator were converted to a 100-point scale. The results are presented in the table.

Table 20 Improvement Based on Critical Thinking Indicators

Indicator	Experimental Pretest	Experimental Posttest	Experimental N-Gain	Control Pretest	Control Posttest	Control N-Gain
Interpretation	58.40	88.80	0.73	58.10	72.40	0.34
Analysis	54.70	87.50	0.72	54.20	70.10	0.35
Evaluation	50.60	85.90	0.71	51.00	68.00	0.35
Inference	52.80	86.60	0.72	52.40	69.30	0.36
Explanation	51.90	85.60	0.70	51.70	67.80	0.33
Self-regulation	50.20	82.90	0.66	52.10	66.20	0.29
Average	53.10	86.22	0.71	53.25	68.97	0.34

The highest improvement in the experimental group was observed in the interpretation indicator, with an N-Gain of 0.73. Following the instruction, students demonstrated a greater ability to comprehend the game's challenges and identify relevant information. The analysis and inference indicators also showed significant improvement. Students became better at linking player positioning to strategic success, and conclusions were no longer drawn without

justification; instead, insights gained during exploration and tournaments served as evidence to support their answers.

Self-regulation recorded the lowest score among the indicators; its N-Gain of 0.66 fell within the moderate category. While some students could identify strategic weaknesses, they were not always able to articulate the evolution of their thought processes. This indicator appears to require a longer period of practice to develop. In the control group, improvements across all indicators fell into the moderate or low categories. Indicators ranging from interpretation to explanation showed moderate gains, whereas self-regulation achieved an N-Gain of only 0.29, placing it in the low category.

Summary of Key Results

Test results revealed several key findings. The J-Sported model proved applicable, achieving an average implementation rate of 92.18 percent. Teacher and student response rates were 93.33 percent and 92.03 percent, respectively; both figures fall into the "highly practical" category. There was no significant difference in the initial capabilities of the experimental and control groups. After six sessions, the experimental group achieved an average post-test score of 86.22, while the control group scored 68.97. This difference was statistically significant ($p < 0.001$).

The experimental group's N-Gain score was 0.71, placing it in the high category, whereas the control group scored 0.34, falling into the medium category. Improvements were observed across all critical thinking indicators, with the highest gains seen in interpretation. Self-regulation showed a smaller increase but still demonstrated a meaningful change. Overall, the J-Sported model met the criteria for practicality and effectiveness. These findings complement the expert validation results from the preceding stage, confirming that the product satisfies the three primary benchmarks of development research: feasibility, practicality, and effectiveness. These three criteria also served as the basis for product evaluation within the research design.

4. Discussion

Feasibility of the J-Sported Learning Model

Validation results indicate that the J-Sported model achieved a feasibility score of 91.67 percent, placing it in the "highly feasible" category. These results demonstrate not only that the product meets content requirements but also that the alignment between learning objectives and designed activities is robust. The model is ready for implementation following minor refinements to the language, time allocation, and assessment rubric. This high level of feasibility stems from the fact that the model is structured as more than just a sequence of games; it comprehensively incorporates the essential components of a learning model. It outlines learning objectives, the instructional syntax, and the social system, while also defining the roles of both teachers and students. Furthermore, it provides support systems and evaluation tools. This structure ensures the model goes beyond a mere general concept requiring further interpretation by teachers [12].

An instructional expert validation score of 90.83 percent confirms the logical flow of the model. The initial stage does not immediately jump to technical drills; instead, game-based problems are introduced first to focus student attention on the intended learning outcomes. This is followed by movement exploration, where proposed solutions are not simply accepted but are tested through gameplay. Validation by an evaluation expert yielded a score of 91.67 percent, indicating that the assessment instruments align with the model's development goals. The tests do not merely require students to name techniques; rather, they present game scenarios that challenge students to comprehend the problem, select an appropriate strategy, and articulate the rationale behind their decisions.

Alignment of the Model with Junior High School Student Characteristics

The J-Sported model is considered well-suited to the developmental stage of junior high school students because the problems presented are concrete in nature. Situations such as losing possession of the ball or failing to utilize playing space effectively are easily observable. Students are not required to discuss abstract concepts far removed from their own experiences; instead, reasoning is developed through events just experienced during play [13].

At the junior high school age, interest in peer interaction becomes quite strong. Consequently, group work serves as a central component of the model. Strategies are not formulated individually; rather, opinions must be voiced and compared with those of other group members. The resulting collective decisions are then tested during the game.

Strengths of the J-Sported Model Syntax

The primary strength of the J-Sported model lies in the interconnectedness of its stages. The problem-triggering element in the initial stage provides direction for subsequent activities; exploration is not aimless or unstructured. Instead, every attempt is guided by the need to address the identified problem [14]. Reflection is positioned as the final stage to ensure the learning experience extends beyond the conclusion of the game itself. Students are prompted to revisit the initial problem. Successful strategies are explained, while less effective ones are examined. This process enables the formulation of conclusions and plans for improvement. Teacher questioning plays a pivotal role in this process. Rather than immediately providing solutions, the teacher employs questions that prompt students to consider why a strategy failed or what adjustments are necessary. Research on game-based learning indicates that the timing and quality of questions are crucial for fostering tactical awareness. Questions that are overly general or poorly timed may cause students to revert to a passive state, simply waiting for the teacher to provide the answer.

Implications of Model Implementation

Model implementation reached 89.24 percent during the limited trial, a figure that rose to 92.18 percent during the expanded trial. This increase indicates that the improvements made following the limited trial phase positively impacted the smooth conduct of the learning activities. During the limited trial, obstacles were encountered during the movement exploration phase, as students tended to wait for answers. However, the activities proceeded more effectively after instructions were shortened and role assignments were clarified. These changes demonstrate that practicality is not determined solely by the quality of the model's underlying concepts; the language used and the structuring of tasks—even when seemingly simple—also play a significant role. The critical reflection phase received the lowest score, although it still fell within the "very good" category. This stage requires a shift in habits; students accustomed to simply ending the lesson after the game needed guidance to review and reflect on their experiences. Consequently, some responses remained brief and lacked clearly articulated, compelling reasoning.

Ease of Implementation for Teachers

Teacher response during the extensive field trial reached 93.33 percent. This indicates that the model is understandable and can be implemented without requiring major changes to the Physical Education (PJOK) schedule. Teachers are not required to use specialized facilities; existing fields and equipment remain suitable for use. The guidebook assists teachers in preparing questions. This component is crucial, as the primary challenge identified during the needs analysis was the formulation of Higher-Order Thinking Skills (HOTS) questions. With the provided list of questions, teachers do not need to create everything from scratch, yet the questions can still be adapted to specific classroom conditions [15].

Student Response to the Learning Process

Student response reached 92.03 percent. The highest ratings were associated with the engaging nature of the lessons; games and mini-tournaments made the activities feel more dynamic. The designed strategies allowed for immediate practical application, ensuring that discussions did not feel disconnected from the actual practice. Slightly lower ratings were observed regarding the reflection component. Some students found it easier to respond verbally than in writing; consequently, the reflection format was kept concise. Responses could be conveyed through key points without compromising the requirement to provide supporting reasons.

Model Flexibility and Facility Limitations

The flexibility of the J-Sported model is evident in the ability to modify the playing area and the number of players. Games can be conducted in small groups, meaning the available balls do not need to be used by the entire class simultaneously, and the size of the playing area can be reduced. This flexibility suits the reality of many schools with limited facilities. The model does not rely on digital devices or standard match-sized courts; simple equipment can be utilized effectively, provided that safety and learning objectives are maintained.

The Status of J-Sported as a Practical Model

The model's practicality is defined by several factors: teachers can readily understand its instructional sequence (syntax); the materials are not overly complex; and the lesson duration remains manageable. Furthermore, students can follow the activities without requiring extensive re-explanation. An implementation rate of 92.18 percent and a user response rate exceeding 92 percent demonstrate that the model is viable beyond mere theory; the product has been successfully implemented in full-class settings. Any obstacles that arose could be resolved through technical adjustments.

Comparison with Previous Research

The findings of this study align with research on game-based learning that highlights increased student engagement. Similarities are particularly evident in the use of game contexts and tactical problems; students are not merely asked to demonstrate techniques but are guided to understand the game itself. The distinction lies in the model's structure. J-Sported specifically integrates six elements: contextual problems, inquiry, collaboration, tactical games, educational competition, and critical reflection. All these elements are organized into a fixed instructional sequence [16]. The novelty of J-Sported does not lie simply in the use of games, as games have long been utilized in physical education. Instead, the distinguishing feature is the link established between the game and the assessment of critical thinking. Each stage is designed to prompt students to formulate reasons and provide evidence based on their movement experiences.

Effectiveness of the J-Sported Model on Critical Thinking Skills

The effectiveness of the J-Sported model can be observed through changes in critical thinking skill scores before and after instruction. In the experimental group, the average pretest score was 53.09; after six sessions, this figure rose to 86.22, representing an increase of 33.13 points. An increase was also observed in the control group, where the average score rose from 53.25 to 68.97—an increase of 15.72 points. Prior to the intervention, the initial abilities of both groups were nearly identical, with a pretest mean difference of only 0.16 points. The initial difference test yielded a significance value of 0.934. Since this value exceeded 0.05, the initial abilities of the two groups could be considered comparable. This is significant because it ensures that the posttest difference did not stem from a substantial initial disparity in ability.

Following the intervention, the difference became more pronounced. The experimental group's average posttest score was 17.25 points higher than that of the control group. An independent samples t-test yielded a t-value of 13.099 with a significance level of less than 0.001. Thus, the difference was not merely descriptive; the results were also statistically significant. The educational implications of these findings extend beyond the mere observation that one group achieved higher scores. The results demonstrate that when students are given the opportunity to analyze game situations, experiment with strategies, and evaluate outcomes, their thinking skills can develop more robustly. Physical activities were not simply repeated until the technique appeared correct; rather, the playing experience served as a basis for understanding problems and making decisions.

Significance of the Pretest-Posttest Difference

The score increase in the experimental group demonstrates that critical thinking skills are not static; they can be developed when learning experiences are intentionally designed. In this study, students were not merely presented with questions during the test itself; processes of interpretation and analysis were employed from the initial problem-triggering stage [17].

Following the implementation of the model, students' responses began to shift. They were able to identify game-related problems with greater specificity. For instance, a failed attack was no longer attributed solely to a lack of teamwork; factors such as players positioning themselves too closely together and the failure to exploit open spaces were also cited as causes. Consequently, the solutions proposed became more targeted.

Differences Between the Experimental and Control Groups

The improvement observed in the control group indicates that conventional practice remains beneficial. Techniques can be mastered through demonstration and repetition, and a basic understanding of the rules can be acquired through teacher explanations; thus, the control group's results did not remain stagnant. The situation differed for the experimental group. Answers were not immediately provided by the teacher; instead, students were required to identify problems and test various alternatives. Through these activities, the thinking process did not occur merely after the lesson but was integrated into the core activities. The performance gap between the two groups also demonstrates that physical activity alone is insufficient to generate significant improvements in critical thinking. Both groups engaged in movement and gameplay, yet the distinction lay in the structure of the learning experience. In the J-Sported approach, problems, questions, and strategy testing were intentionally designed [18].

Interpretation of Hypothesis Test Results

The hypothesis test results show a significance value of less than 0.001. The null hypothesis—stating there is no difference in improvement between the experimental and control groups—was rejected. The J-Sported model was found to have a significant effect on critical thinking skills. The difference in post-test means reached 17.25 points. The experimental group's N-Gain was also 0.37 points higher than that of the control group. These two findings indicate that the model's impact was not merely a minor difference that happened to be statistically significant. A Cohen's *d* value of 3.27 indicates a very large effect size. This value reflects a substantial gap between the two groups' results relative to the variation of scores within the groups. In practical terms, the students participating in the J-Sported model experienced more than just a marginal change.

Interpretation of N-Gain

The average N-Gain for the experimental group was 0.71, placing it in the high category. The control group obtained a score of 0.34, falling into the medium category. These results illustrate the proportion of improvement achieved relative to the potential for improvement that remained available. In the experimental group, 19 students fell into the high N-Gain category, while 13 students were in the medium category. No students fell into the low improvement category. This distribution indicates that the impact of the instruction was not concentrated solely among students with high initial ability. The absence of students in the low category within the experimental group may be attributed to the use of small groups. Students who were unable to formulate strategies independently could still hear the reasoning of their peers. They could then observe the outcomes of the strategies as the game was played. Consequently, the learning experience did not rely solely on individual ability.

Improvement in Interpretation Skills

The interpretation indicator achieved the highest N-Gain score at 0.73, with the score rising from 58.40 to 88.80. At this stage, students were required to comprehend the situation and identify the core issue—abilities frequently utilized from the very beginning of the J-Sported program. Problem-triggering scenarios compelled students to closely observe the game before a solution was proposed. They had to distinguish between symptoms and root causes; for instance, a team failing to score was not immediately assumed to possess poor technique. Positional patterns and the flow of the ball were also observed.

Improvement in Analytical Skills

Analytical skills improved from 54.70 to 87.50. An N-Gain of 0.72 indicates a high level of improvement. This shift became evident as students began to connect specific actions with their consequences within the game. Early in the study, student responses often consisted of

simple, singular judgments. Strategies were dismissed as incorrect without an explanation of the specific elements that caused the failure. As lessons progressed, the interrelationships between game components began to be articulated; player positioning, passing distances, and opponent movements were interpreted as an interconnected sequence of events.

Improvement in Evaluation Skills

Evaluation scores rose from 50.60 to 85.90, yielding an N-Gain of 0.71. This indicator required students to assess the appropriateness of a strategy based on observed outcomes. This improvement occurred because group strategies were not automatically deemed correct simply upon formulation; they had to be tested. Subsequently, their successes and weaknesses were scrutinized, requiring students to substantiate their assessments with evidence from the gameplay.

Improvement in Inference Skills

Inference skills improved from 52.80 to 86.60. The N-Gain score of 0.72 falls into the high category. Students began to draw conclusions based on multiple experimental outcomes. During the exploration phase, a single strategy could be tested more than once, with results not always being identical. Students had to consider the most frequently occurring pattern before drawing a conclusion. This process reduced the tendency to determine an answer based on a single event.

Improvement in Explanation Skills

Explanation scores rose from 51.90 to 85.60. The N-Gain score of 0.70 sits at the threshold of the high category. This shift indicates that students began to articulate the reasoning behind their decisions. Initially, answers were often brief; students would select a strategy without providing a clear rationale. Following the implementation of J-Sported, however, their answers began to incorporate information derived from gameplay experience.

Improvement in Self-Regulation

Self-regulation scores rose from 50.20 to 82.90. The N-Gain score of 0.66 falls into the moderate category. While the improvement was substantial, this figure represents the lowest result among the various indicators. Self-regulation requires students to examine their own thought processes. This task is more challenging than evaluating externally observable strategies. Students must acknowledge when an initial decision was flawed and subsequently identify the reasons for the error.

The Relationship Between Movement Problems and Thought Processes

Movement problems serve as a link between physical activity and critical thinking. Students are not presented with problems detached from the learning experience; instead, the issues arise from actual game situations [19]. This connection renders the thought process more contextual. If the playing space is not utilized effectively, the consequences are immediately apparent: the ball becomes difficult to move, and players are easily marked by opponents. Such information is more readily understood than purely verbal explanations.

The Role of Movement Exploration

Movement exploration provides students with the opportunity to generate knowledge through experimentation. Answers are not simply provided by the teacher; instead, various alternatives must be tested so that the differences can be experienced firsthand. Mistakes take on a different significance as well. They are not viewed merely as something to be avoided; rather, suboptimal outcomes serve as valuable information, allowing students to identify areas requiring improvement.

The Role of Tactical Games

Tactical games are used to place skills within a meaningful context. Techniques are not practiced in isolation for extended periods; instead, their application is directly linked to the objectives of the game [20]. Tactical games foster interpretation and analytical skills. The

scenarios are realistic yet less complex than a full-scale match, making it easier for students to recognize patterns and test different options.

The Role of Group Strategy Formulation

Formulating strategies in a group ensures that the thinking process is not a solitary endeavor. Opinions must be voiced and compared, and students are required to consider their peers' reasoning before a collective decision is reached. Group work also benefits students with lower initial proficiency levels, as they can hear how their peers explain problems. Knowledge is not simply received from the teacher but is constructed through interaction.

The Role of Mini-Tournaments

Mini-tournaments introduce a more realistic level of game pressure. Students must apply strategies while opponents attempt to thwart them, requiring faster decision-making. Process-based assessment is used to ensure students focus on *how* they play; teamwork and strategy application are also observed. A winning team does not necessarily receive the highest process assessment score if the game relies on a single student [21].

The Role of Critical Reflection

Critical reflection ensures the game experience is not merely a fleeting activity. Actions are reviewed, and reasons are compared against outcomes, allowing for the formulation of improvements. Reflective questions are limited to three core areas: the strategies employed, the evidence of success or failure, and the necessary changes. Keeping the number of questions low allows for deeper discussion of the answers.

The Role of the Teacher as Facilitator

The teacher's role is not eliminated in J-Sported; rather, the quality of teacher intervention becomes crucial. The shift lies in *how* assistance is provided. Teachers do not immediately reveal answers when a strategy fails; instead, they use questioning first. Assistance is provided gradually to ensure students retain the space to think for themselves.

Connection to Critical Thinking Theory

The six indicators used in this study are interconnected. Interpretation serves as the starting point for understanding the problem. Analysis is employed to examine the relationships between pieces of information. Evaluation is necessary to assess the strength of various options. The J-Sported syntax accommodates all these indicators. Problem-triggering activities primarily foster interpretation. Exploration and tactical games largely activate analytical skills. Strategy testing and tournaments facilitate evaluation and inference [22].

Educational Implications of the Model's Effectiveness

The research findings demonstrate that critical thinking skills can be developed without compromising the active nature of Physical Education (PJOK) lessons. Students remain physically active and engaged in play. The shift lies in how movement experiences are designed and discussed. The model also shows that Higher-Order Thinking Skills (HOTS) need not be delivered solely through lengthy written questions; movement-based problems can serve as a source for high-level thinking. While written assessment remains necessary, the process of developing these skills takes place on the field of play. From the teacher's perspective, J-Sported offers a middle ground between the command style of teaching and free play. Direct instruction can still be utilized for safety purposes or to teach specific techniques, yet students are still afforded opportunities to make decisions.

Shifting from Teacher-Centered to Student-Centered Learning

The J-Sported model demonstrates a shift in instructional patterns from a teacher-controlled approach to one that grants students greater autonomy. In traditional instruction, decisions regarding movement forms and strategies were typically predetermined, with students simply following provided instructions. Such patterns remain useful in specific contexts—particularly when introducing fundamental techniques or prioritizing safety. Under the J-

Sported model, the teacher's role is not eliminated but redefined as an activity guide and a facilitator of the thinking process. Teachers prepare game-related challenges and pose guiding questions, yet they do not immediately dictate the answers. Instead, students are given the opportunity to observe, experiment, and formulate their own decisions [23].

Integrating Movement and Thinking Processes

A key finding of this study is the potential to integrate physical activity and cognitive processes within a single activity. Physical education (PE) is often perceived primarily as a venue for developing physical capabilities, while cognitive processes are treated as supplementary elements delivered through theoretical explanations or written tests. The J-Sported model narrows this divide. Physical activity serves as a source of information; movement challenges arising on the field become subjects for analysis; selected strategies are tested through action; and the resulting movement outcomes are then used to draw conclusions.

J-Sported as HOTS-Oriented Learning

In J-Sported, the HOTS (Higher-Order Thinking Skills) orientation is not limited to the evaluation phase; higher-order thinking skills are integrated from the very beginning of the lesson. Game-based problems are presented prior to the main practice session, requiring students to comprehend the issue and identify cause-and-effect relationships. During the exploration stage, various alternatives are tested—a process that demands analysis and comparison. As students formulate group solutions, they employ inferential skills, determining the most appropriate course of action based on available information.

The Relationship Between Physical Activity, Decision-Making, and Reflection

Physical activity in J-Sported serves purposes beyond merely increasing movement intensity; it incorporates situations that necessitate decision-making. For instance, students must choose between retaining possession of the ball and executing a pass, or determine their positioning as the game space shifts [24]. The clear consequences of these choices provide a solid basis for reflection. Students move beyond expressing opinions based on guesswork, instead using their gameplay experiences as evidence. Consequently, the relationship between actions and outcomes becomes easier to understand.

The Novelty of the J-Sported Model

The novelty of the J-Sported model lies not merely in the use of games within Physical Education (PE) instruction—as games have long been utilized in the field—but rather in how various approaches are integrated into a single model with a fixed instructional sequence (syntax). Contextual problems serve as the starting point for learning. Inquiry is subsequently facilitated through movement exploration. Collaboration is fostered during the formulation of group strategies. Tactical games are employed to clarify the relationship between actions and game objectives. Another aspect of novelty is the link between the model's syntax and indicators of critical thinking. Each stage possesses a specific cognitive focus: the problem-triggering phase relates to interpretation; exploration relates to analysis; strategy testing supports evaluation and inference; and discussion and reflection facilitate explanation and self-regulation.

Contribution to the Development of PE Learning Theory

Theoretically, this research demonstrates that PE learning models can be designed by positioning physical activity as a medium for developing reasoning skills. Movement is not viewed solely as a learning outcome; it also serves as a source of problems and evidence. J-Sported provides a framework wherein thinking processes are cultivated through three primary relationships: first, the link between game problems and exploration; second, the link between decision-making and testing; and third, the link between action outcomes and reflection.

Differences Between J-Sported and Other Learning Models

J-Sported shares several similarities with problem-based learning, inquiry-based learning, and the tactical games approach. These similarities are evident in the use of problems and active student engagement. However, this model is not identical to any of those approaches. J-Sported also bears a resemblance to TGfU, as it prioritizes tactical understanding over an excessive emphasis on technique. The distinction lies in its explicit reinforcement of critical reflection and the assessment of critical thinking indicators [25]. Consequently, J-Sported was not created by simply replicating a single existing model. Instead, specific elements were selected and reconfigured to meet the study's requirements. The final result is a pedagogical framework specifically designed to enhance the critical thinking skills of junior high school students.

Potential Application to Other Sports Topics

This study tested the model using large-ball game activities. However, the model's structure is adaptable for use with other subject matter. Adjustments would primarily be required regarding the types of problems presented and the nature of the game activities. In athletics, J-Sported can be applied through modified movement challenges. For instance, pacing strategies could be employed in middle-distance running; students could test different pacing patterns and then evaluate the outcomes [26]. Nevertheless, not all topics can utilize the exact same format. Activities involving higher risk levels require greater teacher guidance. Modifications are necessary to ensure that exploration does not compromise safety.

5. Research Implications

Theoretical Implications

The research results imply that critical thinking skills can be developed through physical activity-based learning. Traditionally, thinking processes have been closely associated with classroom-based learning. The findings demonstrate that game situations can also be utilized to foster interpretation, analysis, and evaluation. Consequently, Physical Education (PE) instructional models need to be viewed from a broader perspective. Learning objectives should not focus solely on movement accuracy; students' abilities to articulate reasoning and make decisions can also be incorporated as learning outcomes.

This study also highlights the importance of reflection in physical education. Movement experiences become more meaningful when reviewed. Reflection has also been employed to link game outcomes with critical thinking indicators. Theoretically, J-Sported can be positioned as an integrated instructional model. It connects problem-based and inquiry approaches with tactical game concepts, while also integrating collaboration, educational competition, and critical reflection.

Practical Implications for PJOK Teachers

For PE teachers, this study offers an instructional model that remains closely aligned with field-based activities. Changes do not require a reduction in physical activity; rather, the primary adjustments involve how games are designed and how questions are posed. Teachers can use game-related problems as an opening activity. Student answers do not need to be corrected immediately; instead, students should be given the opportunity to test their chosen options. Once the activity concludes, the reasoning and outcomes can be discussed collectively. Guidebooks and teaching modules can assist with initial implementation, though adjustments remain necessary. Factors such as class size, equipment availability, and playing field dimensions must be taken into account.

Teachers also need to allocate time for reflection. This stage is often easily curtailed because games tend to run longer than expected; however, without reflection, the goal of fostering critical thinking may be compromised. PE assessment practices can also be expanded. While movement skills remain a component of evaluation, the ability to read situations and explain decisions can also be included. Simple rubrics can be used to ensure the assessment process does not place an excessive burden on teachers.

Implications for Students

For students, J-Sported demonstrates that Physical Education (PE) requires more than just physical ability; opinions and reasoning also play a role in the learning process. Students are

encouraged not to rely solely on the teacher's answers. Group work helps build the confidence to express opinions, though it also entails responsibility. Decisions made collectively must be tested, and the outcomes subsequently discussed with honesty.

Students also learn to accept that mistakes are part of the learning process. A strategy that fails is not immediately viewed as an ultimate failure; instead, the cause is identified, and improvements are attempted. These habits can be applied beyond PE lessons. The ability to evaluate information, provide reasoning, and refine decisions is essential in daily life.

Implications for Schools

Schools need to provide teachers with the scope to employ more varied teaching methods. Support does not always require purchasing expensive facilities; time for lesson planning and collaboration with other teachers is also crucial. Internal training can be conducted to help teachers understand HOTS (Higher-Order Thinking Skills)-based learning in PE. Often, HOTS is perceived merely as a type of test question, but J-Sported allows HOTS to be integrated into the actual learning process. Schools can also utilize existing equipment by modifying it; limited facilities need not be a major obstacle. Group arrangements and the size of the activity area can be adjusted accordingly. Research findings can serve as a basis for developing PE curricula. Schools can encourage a more balanced assessment approach that considers physical skills, thinking abilities, and social attitudes.

Implications for Curriculum Development

Physical Education (PE) curricula need to provide clearer scope for decision-making and problem-solving. Learning outcomes should not merely translate into technical mastery; activities involving analysis and evaluation must be incorporated into learning objectives. Instructional modules can be designed to include movement-based problems. Guiding questions should be linked to game situations, and assessment methods can utilize context-based questions alongside performance rubrics. J-Sported demonstrates that a Higher-Order Thinking Skills (HOTS) orientation can be implemented without compromising the essential character of PE. Consequently, similar models could be integrated into active learning enhancement programs or teacher training initiatives. Curricula also need to allocate time for reflection. While reflection is often overlooked as a core component, it is essential for transforming movement experiences into genuine understanding.

Implications for Physical Education Research

This research opens opportunities to examine the relationship between physical activity and cognitive processes in greater detail. Each stage of the J-Sported model can be studied independently—for instance, the impact of movement exploration on analysis, or the effect of reflection on self-regulation. Testing across different types of sports is also necessary. Results observed in large-ball games cannot simply be assumed to apply to athletics or gymnastics, as the nature of the specific activity can influence implementation. Longitudinal research is required to determine the sustainability of any improvements. Furthermore, the extent to which critical thinking skills transfer to other academic subjects or real-life contexts remains unknown. Employing mixed-methods research could yield deeper insights. Test scores could be combined with student interviews and recordings of group discussions, allowing for a more comprehensive understanding of changes in thought processes.

6. Research Limitations

This study has several limitations. The research was conducted at only one junior high school; the school's characteristics and the teachers' habits could influence the results. Therefore, generalizing the findings to all schools requires caution. The number of subjects in the large-scale trial was only 64 students. While this sample size was sufficient for the analysis performed, the diversity of student backgrounds was limited, preventing comparisons regarding differences in school environments and learning cultures. The intervention spanned six sessions. Although this duration was sufficient to demonstrate changes in critical thinking skills, developing thinking habits particularly self-regulation may require more time. The instructional material was limited to large-ball games. The model's effectiveness regarding individual sports and

fitness activities has not been directly tested, nor have the necessary modifications for those activities been determined.

Critical thinking skills were assessed using essay tests and process observations. Although the instruments were validated, the results were still influenced by students' writing abilities; some students might have understood the strategies but struggled to articulate them clearly in writing. Implementation assessment relied on human observers. Differences in interpretation could occur despite the use of a clarified rubric. While video recordings could facilitate re-examination, they were not utilized for every session. External factors could not be fully controlled. Student motivation, health conditions, and peer relationships could influence engagement levels. Furthermore, students' experiences with sports outside of school were not specifically analyzed. The very large effect size observed must be interpreted within the context of two classes at the same school. These results might not be replicated at a similar level if the model were implemented in a more diverse range of schools.

7. Conclusions and Recommendations

Conclusions

A J-Sported-based Physical Education (PJOK) learning model was successfully developed using the ADDIE framework. The analysis phase identified learning needs, followed by the design phase, which involved structuring the model's components and syntax. The product underwent validation and revision prior to the implementation of limited and extensive field trials. The resulting products include a model guidebook, teaching modules, and student worksheets. Assessment tools and critical thinking instruments were also developed. The model's syntax comprises six stages: a game-based problem trigger and inquiry-based movement exploration. Subsequent stages involve reinforcing tactical understanding and designing team solutions. A mini-tournament is conducted before the lesson concludes with critical reflection and a Higher-Order Thinking Skills (HOTS) assessment.

Expert validation results yielded an average score of 91.67%, placing the model in the "highly feasible" category. Subject matter experts rated it at 92.50%, instructional experts at 90.83%, and evaluation experts at 91.67%. The model's practicality was demonstrated by a 92.18% implementation rate during the extensive field trial. Teacher response reached 93.33%, while student response was 92.03%; all these results fall into the "highly practical" category.

The model's effectiveness was evident in the improved critical thinking skills of the experimental group. Their average score rose from 53.09 to 86.22, whereas the control group's score shifted from 53.25 to 68.97. The difference in post-test scores and N-Gain values between the two groups was statistically significant ($p < 0.001$). The experimental group achieved an N-Gain of 0.71 (high category), while the control group scored 0.34 (medium category). A Cohen's d value of 3.27 indicates a very large effect size within the context of this study.

Improvements were observed across all critical thinking indicators. The "interpretation" indicator achieved an N-Gain of 0.73, while "analysis" and "inference" each reached 0.72. The evaluation score was 0.71. The explanation component reached 0.70, while self-regulation stood at 0.66. Based on the overall findings, the J-Sported model is deemed feasible, practical, and effective for enhancing the critical thinking skills of junior high school students. The model's primary contribution lies in the integration of physical movement activities with cognitive processes. Game-based situations were utilized to develop the ability to comprehend problems, formulate decisions, and evaluate outcomes.

Recommendations

1. For Physical Education (PJOK) Teachers

The J-Sported model can serve as an alternative approach for lesson content involving tactical situations. Game-based challenges should be tailored to students' abilities. Guiding questions should be kept concise so that the activity does not consume too much practice time. The reflection phase should be maintained, even when lesson time is limited. Teachers are also encouraged to rotate roles so that all students participate in discussions and decision-making.

2. For Schools

Schools are expected to support the implementation of active, HOTS-oriented (Higher-Order Thinking Skills) physical education. This support can be provided through teacher

training and forums for sharing instructional materials. The utilization of existing facilities should also be optimized. Equipment and playing areas can be modified to allow the model to be implemented without waiting for complete facilities to become available.

3. For Students

Students are encouraged to be more active in articulating their reasoning during lessons. Strategic errors should be viewed as opportunities for improvement. Cooperation and sportsmanship must be upheld, as group decision-making is a key component of the J-Sported model. Reflection activities should be conducted honestly; there is no need to conceal suboptimal decisions. In fact, acknowledging such shortcomings can actually enhance the learning process.

4. For Curriculum Developers

Curriculum developers are advised to explicitly incorporate decision-making and problem-solving activities into physical education instructional materials. Assessments targeting HOTS should also be designed around movement and game-based scenarios, ensuring that HOTS is not assessed solely through written tests. The J-Sported model could be considered as a reference when developing physical education teaching modules that integrate the cognitive and psychomotor domains.

5. For Future Researchers

Further research could be conducted with a larger number of schools and subjects. The duration of the intervention should also be extended to better observe the development of self-regulation. The model could be tested using volleyball, badminton, and athletics or physical fitness activities. Comparisons of its implementation at the elementary and high school levels could also be made. A mixed-methods approach is recommended so that changes in scores can be explained through interview data and discussion recordings. Retention of results after several weeks should also be measured to determine the sustainability of the model's impact.

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