4.3. COGNITIVE AND RESEARCH ACTIVITY IN PHYSICAL EDUCATION AND SPORT

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Abstract. *The section examines cognitive and research activity in physical education and sport as an integral component of the professional development of higher education students. Cognitive and research engagement is interpreted as a holistic formation that combines motivational, cognitive, activity-based, and reflective dimensions, ensuring the transition from the reproductive performance of motor tasks to conscious, research-oriented analysis of one's own physical activity. The aim of the study is to substantiate pedagogical conditions and empirically test a model that fosters such engagement in compulsory physical education classes. Theoretical methods (analysis, synthesis, comparison, modelling) were used to clarify the conceptual framework and to construct a model that integrates research tasks into the structure of physical education. Empirical data were collected through questionnaires, testing, pedagogical observations, expert evaluations, and a pedagogical experiment involving control and experimental groups (comprising 100 students from a faculty of physical education and sport). The model involved the systematic inclusion of mini-research projects, problem-based tasks, and digital tools for monitoring motor activity during classwork. The dynamics of students' engagement were evaluated according to four criteria: motivational (interest in research and internal motivation), cognitive (knowledge of research methods and ability to apply them), activity-based (skills in planning and conducting experiments), and reflective (capacity for self-analysis and self-assessment). Statistical analysis of the results revealed a significant increase in the proportion of students with sufficient and high levels of cognitive and research engagement in the experimental group compared to the control group, as well as a decrease in the proportion of students with low levels. The introduction of research tasks and digital monitoring tools enhanced students' awareness of the value of physical activity, improved their research skills, and fostered a more developed reflective culture. The findings confirm the effectiveness of the proposed pedagogical model and suggest the potential for its broader implementation in physical education courses, sports and wellness programs, and the training of future specialists in physical culture and sport.*

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Introduction

The current educational paradigm is grounded in a competence-based approach that presupposes not only the acquisition of knowledge but also the individual's ability to actively obtain knowledge, apply it in practice, conduct self-analysis, and pursue self-improvement. From this perspective, the development of cognitive and research activities among higher education students becomes particularly significant, especially in the field of physical education and sport, which encompasses intellectual, emotional, and motor forms of activity.

In the twenty-first century, physical culture is viewed not only as a means of maintaining health but also as a domain of scientific inquiry where research methods are used to optimize teaching and training. The development in students of the ability to analyze their own activity, observe, experiment, and draw conclusions supports the growth of critical thinking and a scientific worldview.

The problem of developing cognitive and research activity in physical education is highly relevant in the context of educational reform in Ukraine, particularly the transition to profile schooling and the integration of digital technologies into teaching. Research engagement of higher education students in physical education and sport fosters a more conscious attitude towards their own health, increases motivation to exercise, and supports professional self-development.

The aim of the study is to substantiate the theoretical and methodological foundations and to experimentally verify the effectiveness of pedagogical conditions for the development of cognitive and research engagement of higher education students in physical education.

Research Methods

To ensure a comprehensive examination of the problem of forming cognitive and research activity in physical education and sport, a system of interrelated methods was used that complement each other and ensure the validity of the findings.

1. Theoretical methods

Theoretical methods included analysis, synthesis, generalization, comparison, and modelling.

Analysis and synthesis of scholarly sources made it possible to clarify the essence of the concepts “cognitive activity”, “research competence”, and “cognitive and research engagement”, and to identify the structure and components of research skills in higher education students.

The method of generalization was used to identify leading trends in the development of research activity in contemporary education.

At the stage of theoretical analysis, generalization facilitated the transition from disparate facts and statements presented in the literature to a comprehensive understanding of the structure and mechanisms underlying students’ research activity. As a result, a conceptual model was constructed that integrates cognitive, operational-activity, and value–motivational components.

At the empirical stage, generalization enabled the combination of questionnaire results, pedagogical observations, testing, and expert assessments into a unified system of indicators. This allowed us to identify typical levels of formation of cognitive and research skills (low, medium, sufficient, and high) and to describe their qualitative characteristics.

At the final stage, generalization was employed to interpret the quantitative data and draw conclusions regarding the effectiveness of the proposed model. Comparing the results of different groups and types of activity led to the conclusion that there was a gradual increase in cognitive motivation, a higher level of analytical thinking, and the ability to conduct independent mini-studies.

The method of comparison was used at the theoretical level to juxtapose different approaches to defining the essence of "cognitive engagement", "research competence," and "students' research activity" in the works of Ukrainian and international authors. This made it possible to identify common conceptual features and differences in the way the mechanisms of research skills development are understood.

At the empirical level, comparison was used to assess the dynamics of change in the control and experimental groups during the pedagogical experiment. Comparing pre- and post-test results in the context of research-based teaching technologies allowed us to identify which pedagogical conditions exerted the strongest influence on the formation of an active researcher position in students.

The method of comparison thus served not only as an analytical tool, but also as a means of revealing effective pedagogical practices that foster analytical thinking, independence, reflection, and critical evaluation of one's own activity.

Modelling**.** In pedagogical research, modelling is viewed as a method of scientific inquiry that involves constructing a model – a simplified but structurally adequate system that reflects the essential relationships and connections of a real object. In this study, the object of modelling was the process of developing students' cognitive and research engagement, and the model was a pedagogical system integrating the aims, content, means, forms, methods, and outcomes of this process.

2. Empirical methods

The empirical methods included pedagogical observation, questionnaires, testing, interviews, a pedagogical experiment, and expert evaluation.

Pedagogical observations were conducted during an academic semester to record specific features of students' behavior, interest, and engagement during classes and research-related work.

Questionnaires and interviews were used to explore the motivational, cognitive, and reflective aspects of students' attitudes toward research activities, their experiences of participation in scholarly events, project work, and writing course and qualification papers.

Testing was applied to diagnose the level of development of research skills (the ability to formulate a hypothesis, select research methods, analyze results, and draw conclusions).

The pedagogical experiment followed a quasi-experimental design with control and experimental groups. The experimental group was taught using a specially designed methodology that integrated research tasks into course content to develop cognitive and research skills.

Expert evaluation involved university teachers who assessed changes in students' independence, analytical thinking, and ability to work with scholarly information.

To ensure the validity and reliability of the results, repeated measurements and data triangulation were used. The robustness of the conclusions was supported by an adequate sample size (100 students of the Faculty of Sport and Physical Education) and the use of appropriate statistical procedures.

Research Results

Cognitive and research activity in physical education is an integrative phenomenon that combines elements of cognition, research, self-observation, and self-development. It is grounded in the logic of scientific inquiry, which involves the sequence: problem formulation, hypothesis generation, experiment, analysis of results, and conclusions. Applying this sequence in physical education promotes not only a deeper understanding of the regularities of motor activity but also the formation of research competencies that are essential for students' future professional development.

An analysis of recent studies and publications reveals that in pedagogical and sports science, cognitive and research activities are examined from psychological, methodological, and technological perspectives. In physical education, these ideas have been elaborated by Ukrainian scholars such as Proskurin and

Stadnichenko (2023), Holenkov (2024), and Medvedovska (2024), who emphasize the integration of cognitive and motor components of the educational process.

The problem of cognitive and research activity in physical culture is closely linked to the formation of competence. In particular, competence-based approaches treat research activity as a means of shaping key competences – cognitive, communicative, and health-preserving (Boiko, 2025; Momot et al., 2025).

Recent Ukrainian works view students' cognitive and research engagement as the core of the professional competence of a specialist in physical culture and sport, focusing on the ability to pose research questions, design measurements, and interpret data in the training process. Khomenko (2022) presents a systematic approach to "research competence" and its development in higher education, emphasizing the interconnection of motivational–value, cognitive, and activity-based elements.

A separate body of work addresses the digitalization of physical education, where the integration of mobile applications, fitness trackers, electronic observation logs, and data visualization enhances self-observation, feedback, and reflection, directly fueling students' research engagement. Review and teaching materials published in 2023–2024 summarize these approaches, presenting digital tools as methodological conditions for the transition from "passive exercise performance" to inquiry-based and analytical learning (Yudenko, 2024).

Other publications focus on motivational and reflective dimensions, as the formation of interest in physical education and the development of a reflective culture in the educational process are seen as prerequisites for stable, research-oriented behavior (Lazarenko & Balashov, 2021).

In the Ukrainian educational context, there has been a gradual expansion of research tasks in physical education classes, including keeping self-monitoring diaries, using fitness applications, participating in student research conferences, and developing individual learning projects focused on health monitoring. These methods bring together pedagogical, motivational, and research aspects of teaching.

Recent international studies by Tendinha and Alves (2023) and Kitching (2024) indicate that involving students in self-monitoring their physical activity using digital devices enhances analytical thinking, self-reflection, and motivation to exercise. According to the World Health Organization's Global Status Report on Physical Activity (2022), over 25% of adults do not meet the recommended levels of physical activity, which underscores the need for educational strategies that promote a more conscious approach to movement.

At the policy level, the reform of senior profile school (Reforma starshoi profilnoi shkoly, 2024) targets competence-based learning outcomes and individual educational trajectories, opening a "window of opportunity" for more extensive implementation of research practices in physical education at the school–university interface (continuity of content, integration of STEM/HEALTH components).

Taken together, the sources reviewed suggest the methodological expediency of combining theory with micro-research tasks during classes, the key role of digital technologies in collecting and analyzing learning data, the need for targeted development of motivational and reflective dimensions, and alignment with the competence logic of current educational reforms. This provides a sound scholarly basis for implementing pedagogical models to develop cognitive and research activity in physical education and sport.

Methodological Foundations

From a methodological standpoint, cognitive and research activity in physical education is based on the following approaches.

Activity approach. Learning is understood as active engagement aimed at independent discovery of knowledge. In physical education, this approach is realized through the observation of exercise performance, independent analysis of movement effectiveness, and the design of individualized training plans. Research tasks become a means of self-exploration, and the teacher serves as a facilitator of cognitive activity.

Competence-based approach. The goal of education is defined as the development of the ability to apply knowledge in practice. In physical education, this approach involves developing skills to analyze one's health status, assess physical indicators, and identify ways to improve them. Research activity becomes an instrument for developing self-assessment and self-control.

Learner-centered approach. Teaching is oriented toward the individual needs, abilities, and interests of the learner. In cognitive and research activities, this approach involves learners in selecting research topics, formulating individual goals and plans, and applying their own experiences to address pedagogical problems.

Information and digital approach. Under conditions of educational digitalization, the use of mobile applications, fitness trackers, and interactive platforms creates new opportunities for collecting and analyzing data on physical activity. This enables the organization of full-scale mini-studies, thereby increasing the objectivity and motivational value of the learning process.

An important methodological guideline is the systems approach, which treats research activity as an interconnected system of components:

- motivational (desire to explore, interest in one's own results);
- cognitive (knowledge of regularities of motor activity and methods of observation and analysis);
- operational (skills in planning experiments and recording results);
- reflective (ability to evaluate achievements, draw conclusions, and adjust one's activity).

The theoretical and methodological basis of cognitive and research activity in physical education thus integrates pedagogical, psychological, and information-based approaches, forming the foundation of a new learning culture – a culture of inquiry.

Psychological Factors and the Role of the Teacher

The development of cognitive engagement is a central goal of education, as it ensures readiness for independent learning and self-organization. In physical education, cognitive engagement has its own distinct characteristics, combining motor, emotional, and intellectual components.

Key psychological factors in the development of cognitive engagement in physical education include:

- Achievement motivation, which drives the desire for improvement, higher results, and exploring new ways of acting;
- Cognitive curiosity, expressed in the desire to understand how the body functions under physical load and to find effective training methods;
- Reflection, which allows students to recognize their own progress, identify mistakes, and rethink experience;
- Self-efficacy, the sense of confidence in one's abilities that drives cognitive and research engagement.

The role of the teacher or coach in organizing cognitive and research activity is pivotal. Rather than acting as a source of ready-made knowledge, the teacher becomes a research supervisor and consultant who helps learners formulate questions, plan experiments, and analyze results. This aligns with the facilitative paradigm of teaching, in which the focus shifts from transmitting knowledge to stimulating its independent construction and development.

An important task for the teacher is to cultivate motivational persistence, since research processes often require time, patience, and the ability to work with errors. Through support, positive reinforcement, and opportunities for choice, the teacher fosters a sense of success and confidence in learners' capacity for inquiry.

Forms and Methods of Cognitive and Research Activity

The study showed that cognitive and research activity in physical education can be implemented in a variety of forms, such as:

- Mini-studies during lessons – short practical tasks (measuring pulse, respiratory rate, recovery speed).
- Individual projects – analysis of one's own physical fitness and the creation of a personal training program with recorded results.
- Group research projects – comparing the effects of different training methods or dietary regimes.
- Interactive movement laboratories – using digital devices (smart bracelets, mobile apps) to collect data.
- Research clubs – extracurricular activities aimed at conducting experiments and participating in conferences.

These forms not only expand students' knowledge but also develop skills in analysis, generalization, and drawing scientific conclusions.

The methods used to organize cognitive and research activity included:

- Problem-question method. Students are presented with situations that require a solution (for example, "How can we optimize a warm-up to improve speed performance?").
- Hypothesis method. Students formulate a hypothesis, which they then test during practical sessions.
- Self-analysis method. Students compare actual results with their forecasts.
- Reflection method. Students analyze their own activity, emotional state, and difficulties.
- Project method. Work culminates in a report, poster, presentation, or mini-article.

The effectiveness of these methods is confirmed in practice: students who regularly complete research tasks show not only improved physical indicators but also growth in analytical thinking, initiative, and responsibility.

Pedagogical Conditions for Developing Cognitive and Research Engagement

Effective development of students' cognitive and research engagement requires specific pedagogical conditions that ensure the coherence and continuity of the process. In this study, the following conditions were implemented: creating a motivational and informational environment, utilizing problem-based research methods, individualizing research tasks, and conducting reflective assessments of cognitive and research outcomes. Their interaction ensures steady growth in cognitive engagement, the development of research skills, and the formation of scientific thinking in physical education and sport.

Below, we outline the content and stages of these pedagogical conditions.

1. Creating a motivational and informational environment

This condition entails establishing a supportive educational and research space that combines information resources, digital technologies, and a system of motivational stimuli. The aim is to foster students' internal interest in scholarly inquiry and to involve them actively in research activities. Implementation includes organizing access to electronic databases, integrating modern educational technologies (LMS platforms, scholarly forums, virtual laboratories), and digital tools for self-monitoring (fitness trackers, online platforms) that strengthen interest in personal results, as well as creating success experiences that support intrinsic motivation for research creativity.

Such an environment allows students to:

- access up-to-date scholarly databases and online courses;
- participate in research seminars and student conferences;
- carry out practical studies using ICT;
- understand the significance of their contribution to sport-related research.

The result is increased cognitive engagement, the development of research initiative, and the formation of information and communication competence.

2. Using problem-based research methods

Problem-based research methods aim to develop critical thinking, the ability to formulate hypotheses, analyze results, and make generalizations. They are implemented through the design of problem situations, experimental tasks, case solutions, project-based studies, and research practicums. These methods foster cognitive independence, planning and organizational skills, and the ability to apply scientific methods in practice. The teacher formulates situations that require analysis, hypothesis generation, and testing, such as: "Which type of warm-up increases the effectiveness of the main exercises?" or "How does heart rate change after different rest intervals?"

The implementation of this condition involves:

– formulating learning and research problems that demand critical thinking;
– using case studies, project methods, heuristic tasks, and experimental methods;
– engaging students in observation and analysis of training and competitive processes;
– working with real physiological and biomechanical data.

This supports the development of analytical thinking, the capacity to formulate and experimentally test scientific hypotheses, and to draw well-founded conclusions.

3. Individualizing research tasks

Individualization means giving students the opportunity to independently determine the topic, purpose, and direction of their research, aligning with their interests, aptitudes, and professional goals. The teacher acts as a facilitator, supporting individual educational trajectories, providing methodological guidance, and monitoring and evaluating progress. Individual research tasks encourage independence, responsibility, and creativity, and deepen the mastery of theoretical knowledge through its practical application.

In practice, this is implemented through:

- allowing students to formulate their own research problems;
- designing individual research plans;
- consulting with a supervising teacher;
- using diverse formats for presenting results (essay, research report, multimedia presentation, article, etc.).

Individualization helps reveal students' creative potential, increases personal responsibility for outcomes, and supports the development of intrinsic motivation for scholarly self-development.

4. Reflective assessment of cognitive and research outcomes

Reflective assessment is the final stage of research activity that ensures students' awareness of their progress, analysis of results, and strategies for improvement. This process includes self-assessment, peer assessment, group discussions of research outcomes, and presentations of individual work. Reflection is a necessary component of cognitive and research activities, as it supports self-control, critical thinking, and a value-based attitude toward scholarly work, enhances professional maturity, and enables not only the assessment of achievements but also the planning of further self-development.

Implementation mechanisms include:

- organizing reflective discussions after research tasks;
- creating a "researcher's portfolio" with interim and final results;
- self- and peer assessment of research projects;
- using criterion-based assessment systems (novelty, coherence, practical relevance, scholarly rigor).

Reflective assessment supports the development of self-control, fosters critical thinking, and promotes the consolidation of motivation for further scholarly inquiry.

The pedagogical conditions, their aims, core mechanisms, forms, and expected outcomes of students' cognitive and research development in physical education and sport are summarized in Table 1.

Table 1.

Pedagogical conditions for developing students' cognitive and research engagement in physical education and sport

Pedagogical condition	*Aim of implementation*	*Main mechanisms and forms of work*	*Expected outcomes*
Creating a motivational and informational environment	Fostering intrinsic motivation for research, developing an information culture	Creating a digital learning space; using educational platforms, e-libraries, research seminars, promoting student research	Higher cognitive engagement, development of research initiative
Using problem-based research methods	Developing research skills and scientific thinking	Problem-based learning, project method, experiment, case method, analysis of training data	Ability to formulate hypotheses, analyze results, and draw scientific conclusions
Individualizing research tasks	Developing students' independence and creative potential	Individual research topics, consultations, project trajectories, and personal reports	Higher personal responsibility, development of independence, and creativity
Reflective assessment of outcomes	Supporting students' awareness of achievements and prospects for growth	Self- and peer assessment, defense of research work, portfolios, and group discussion	Development of reflection and critical thinking, readiness for self-development

Criteria and Levels of Cognitive and Research Engagement

In the experimental work, students' cognitive and research engagement was assessed using four main criteria – motivational, cognitive, activity-based, and reflective. Each criterion was operationalized through indicators that clarify its content and enable the determination of the level of research engagement in physical education and sport.

Motivational criterion

The motivational criterion characterizes students' level of interest, their internal need for cognitive and research activity, and their attitudes towards scholarly inquiry in physical education and sport. It is manifested in:

- interest in participating in research events (conferences, projects, seminars);
- positive attitudes toward scholarly activity and awareness of its importance;
- initiative in completing learning and research tasks;
- striving to independently acquire new knowledge;
- stable motivation throughout the educational process.

Methods used:

- Questionnaire on motivational orientation (adapted from T. Ilyina) to identify leading motives (cognitive, professional, social);
- "Learning motivation" diagnostic method (A. Rean, V. Yakunina) to determine dominant motives of cognitive engagement;
- observation of students' activity during scholarly events;
- self-assessment of motivation using an author scale of research initiative (low, medium, high).

Interpretation: A high level is characterized by a stable interest in scholarly activity, initiative, and a positive emotional attitude toward research.

Cognitive criterion

The cognitive criterion reflects the level of scholarly knowledge and understanding of the theoretical foundations of research activity, including pedagogy, psychology, methodology of physical education, biomechanics, and sport physiology. It is manifested in:

- knowledge of the basics of the scientific method, research logic, and conceptual apparatus;
- skills in identifying problems, formulating hypotheses, and choosing research methods;
- ability to analyze, compare, and generalize information;
- integration of knowledge from other disciplines into research projects.

Methods used:

- testing of theoretical preparedness (questions on research methodology, pedagogy, physiology, biomechanics);
- expert evaluation of knowledge (by department staff);
- analysis of completed learning and research assignments (reports, essays, presentations);
- content analysis of written work to assess depth of argumentation and coherence.

Interpretation: a high level presupposes systematic knowledge, the ability to analyze, generalize, draw conclusions, and apply them to research situations.

Activity-based criterion

The activity-based criterion reflects students' practical ability to conduct research, from planning an experiment to presenting results. It is manifested in:

- ability to plan research (aim, objectives, stages, methods);
- capacity to organize and conduct an experiment in physical education;
- adherence to requirements for data collection, systematization, and processing;

- ability to interpret findings, draw conclusions, and substantiate one's position.

Methods used:

- analysis of individual and group research projects (coherence, scholarly justification, practical value);
- observation of experimental task performance (adherence to protocol, accuracy, consistency);
- teacher observation sheets to record planning, organization, and data-processing skills;
- pedagogical modelling to assess the application of knowledge in simulated teaching or training situations.

Interpretation: A high level means that a student can independently plan, conduct research, and present findings in a well-argued manner.

Reflective criterion

The reflective criterion characterizes students' ability to engage in self-analysis, evaluate their own activities, identify strengths and weaknesses, and define pathways for professional and scholarly growth. It is manifested in:

- ability to analyze one's achievements and mistakes in the research process;
- capacity to relate outcomes to intended goals;
- readiness for self-correction and improvement of one's approaches;
- participation in collective discussions of results and openness to critique;
- having plans for further development in the research sphere.

Methods used:

- "Reflexivity level" diagnostic method (A. Karpov) to assess awareness and depth of self-analysis;
- questionnaire "Self-assessment of research competence" (author modification);

– analysis of student portfolios (diaries, reports, essays) to determine the level of independence in planning and analyzing results;

– reflective interviews after the completion of learning and research projects to assess the capacity to identify future development directions.

Interpretation: A high level is characterized by conscious self-assessment, readiness to analyze mistakes, and a commitment to continuous improvement.

As universal methods applied across all criteria and indicators of research competence in physical education and sport, the study used:

– the expert evaluation method, involving teachers and coaches in assessing competence levels;

– a rating-based self-assessment method, where students evaluated their own achievements on a five-point scale.

Table 2 summarizes the criteria and indicators of students' cognitive and research engagement in physical education and sport.

Table 2

Criteria and indicators of students' cognitive and research engagement in physical education and sport

Criterion	*Description*	*Indicators*
Motivational	Level of interest, initiative, and independence in research	Interest in research; initiative; positive attitude toward science; striving for self-development
Cognitive	Depth of knowledge and ability to apply theory in practice	Knowledge of methodology; understanding of regularities; ability to formulate hypotheses; systemic thinking
Activity-based	Practical implementation of research activity	Planning experiments; organizing observation; data analysis; preparing conclusions
Reflective	Self-analysis, evaluation of results, and improvement	Self-assessment; analysis of mistakes; readiness for correction; planning further development

To determine the level of cognitive and research engagement, four levels were distinguished: low, medium, sufficient, and high.

Level Characteristics

1. High level

General profile. Students with a high level demonstrate stable cognitive motivation, a pronounced orientation toward scholarly inquiry, and self-development. They recognize the importance of research for professional growth and show initiative, perseverance, and creativity in solving problem tasks.

By criteria:

- Motivational: well-formed intrinsic motivation for cognitive and research activity; a need for scholarly self-expression; positive emotional attitude to research; high initiative.
- Cognitive: deep, systematic knowledge of research methodology and theory; ability to independently select methods and analyze scholarly sources; creative approaches to solving cognitive problems.
- Activity-based: ability to independently plan and conduct research, correctly process results, and draw well-grounded conclusions; active participation in scholarly events.
- Reflective: well-developed capacity for self-assessment; in-depth analysis of one’s activity; ability to identify avenues for improvement; presence of a personal research style.

Behavioral indicators: participation in student conferences, preparation of scholarly publications, initiation of research projects, and leadership in group studies.

2. Sufficient level

General profile. These students have a positive attitude toward research, possess basic scholarly knowledge and skills, and require methodological support from the teacher. They are capable of carrying out research tasks with partial assistance.

By criteria:

- Motivational: cognitive interest and a desire for self-realization prevail, though motivation often has an external character (grades, recognition).
- Cognitive: knowledge is fairly complete but not always systematic; students can use research methods under the teacher's guidance; moderate independence in interpreting data.
- Activity-based: they carry out research tasks following a model or instructions; they comply with protocols but do not always analyze results in depth; they possess skills in preparing reports and presentations.
- Reflective: they are able to evaluate their own activity, although reflection is mainly descriptive; they need prompts to identify directions for self-improvement.

Behavioral indicators: participation in research clubs, joint presentations, interest in experimental work.

3. Medium level

General profile. Students at the medium level possess some elements of research skills, but their engagement is situational. Motivation is mostly external, and cognitive activity is episodic.

By criteria:

- Motivational: interest in research is unstable; activity manifests itself only in the presence of external stimuli; there is a degree of indifference to scholarly innovation.
- Cognitive: knowledge is fragmented; limited understanding of research methods; difficulties in analyzing and systematizing information.
- Activity-based: research tasks are completed formally; students reproduce ready-made patterns; inaccuracies occur in planning and analyzing experiments.
- Reflective: self-assessment is insufficiently critical; limited ability to draw conclusions about personal progress; low level of self-correction.

Behavioral indicators: participation in research only at the teacher's insistence, avoidance of extra work, and lack of initiative.

4. Low level

General profile. This level is characterized by the absence of conscious motivation for research, low levels of knowledge and skills, and a passive approach to learning.

By criteria:

- Motivational: indifference to cognitive activity; lack of internal need for research; exclusively external motivation (grades, pressure).
- Cognitive: superficial and often unsystematic knowledge; no understanding of the research process; inability to use basic analytical methods.
- Activity-based: students are unable to independently complete research tasks; they do not follow methodological requirements; results are random.
- Reflective: absence of self-assessment; students do not recognize their mistakes and do not strive for self-improvement.

Behavioral indicators include a lack of interest in scholarly events, failure to complete additional tasks, and passive and formal attitudes toward learning.

Table 3 summarizes the levels of cognitive and research engagement according to the defined criteria.

Table 3

Levels of students' cognitive and research engagement

Level	*Motivational criterion*	*Cognitive criterion*	*Activity-based criterion*	*Reflective criterion*
High	Intrinsic motivation, strong interest	Deep knowledge, independence	Independent research	Developed reflection, adequate self-assessment

Level	*Motivational criterion*	*Cognitive criterion*	*Activity-based criterion*	*Reflective criterion*
Sufficient	Cognitive interest, partial independence	Fair but not fully systematic knowledge	Task performance by instruction	Descriptive self-assessment, awareness of errors
Medium	Unstable interest	Fragmented knowledge	Formal task performance	Superficial self-assessment
Low	External motivation only	Superficial knowledge	Lack of skills	Lack of self-assessment

Organisation and Course of the Pedagogical Study

To verify the effectiveness of the pedagogical conditions for developing cognitive and research engagement in physical education and sport, a pedagogical experiment was conducted.

The objectives were to:

1. Diagnose baseline levels of cognitive and research engagement using the motivational, cognitive, activity-based, and reflective criteria.
2. Implement in practice a pedagogical model that incorporates a specially designed set of forms, methods, tools, and pedagogical conditions for developing cognitive and research engagement in physical education and sport.
3. Carry out a comparative analysis of the dynamics of indicators in the control and experimental groups.

The hypothesis assumed that integrating elements of research activity (mini-projects, experimental observations, reflective analysis, digital self-monitoring tools, etc.) into the classroom structure would increase students' cognitive and research engagement.

The experiment employed a quasi-experimental design, comparing two groups of students: an experimental group (EG) and a control group (CG). Participants were assigned to academic groups to ensure the equivalence of initial indicators.

The study lasted one academic semester (10–12 weeks) and included three stages:

- Diagnostic stage, determining baseline levels of cognitive and research engagement;
- Formative stage, introducing the model of research skill formation into physical education;
- Control stage, summative assessment of changes and their statistical analysis.

Participants were first- and second-year higher education students (aged 18–20) who attended compulsory physical education classes and extracurricular sport sessions. The total sample consisted of 100 participants, with 50 in each group. All students provided informed consent in line with ethical requirements for pedagogical experiments.

At the diagnostic stage, baseline levels of cognitive and research engagement were assessed using four criteria:

- motivational (interest, awareness of research significance, initiative);
- cognitive (knowledge of methods of inquiry in physical education and ability to apply them);
- activity-based (capacity to plan, organize, and conduct micro-studies);
- reflective (ability to analyze results, draw conclusions, and assess one's own activity).

Data collection involved questionnaires, test tasks, observation of learning activities, and students' self-assessment using specific scales. Initial diagnostics revealed no statistically significant differences between the groups.

Formative Intervention

At the formative stage, the experimental group's learning process incorporated a model of cognitive and research development based on systems thinking, integration of theory and practice, an active student role, and reflective self-development.

Throughout the experiment, the following pedagogical modules were integrated into classes:

- *"Question–Hypothesis"* – familiarizing students with the logic of scientific inquiry, formulating research questions and hypotheses;
- *"Data Collection"* – developing skills in measuring and recording physical indicators and using digital monitoring tools;
- *"Analysis and Interpretation"* – processing collected data, constructing tables and graphs, and formulating conclusions;
- *"Communication and Reflection"* – presenting results as mini-reports or posters, conducting self-assessment, and identifying directions for improvement.

Each module combined elements of classroom experiments, independent analytical work, and group discussion. The control group had classes in a traditional format without explicit research components.

The final control stage consisted of repeated diagnostics based on the same criteria as at the beginning of the experiment, a questionnaire assessing students' attitudes toward the new learning model, and a qualitative analysis of reflective reports.

Statistical Processing

Quantitative data were analyzed using descriptive statistics, the Student t-test for independent samples, the paired t-test for within-group changes, and the effect size coefficient (Cohen's d). For data that did not meet the normality assumption, the Mann–Whitney test was applied. Statistical significance was set at $p < .05$.

To minimize the influence of external factors, identical conditions were maintained for all classes (schedule, venue, instructors). To reduce subjectivity, a "blind" assessment of results by external experts was used. Participant selection followed uniform criteria, and adherence to procedures was monitored using checklists.

It was expected that implementing the model would increase:

- levels of intrinsic motivation for cognitive and research activity;
- the ability to independently plan and conduct learning-oriented research;
- the depth of reflective analysis of personal results;
- awareness of the connection between theoretical knowledge and practical aspects of physical improvement.

Baseline and Post-test Results

At the initial stage, both groups showed practically identical levels of cognitive engagement, confirming their comparability. Generalized results are presented in Table 4.

Table 4

Levels of cognitive and research engagement at the beginning of the experiment

Engagement level	*CG (start)*	*EG (start)*
Low	14%	20%
Medium	40%	40%
Sufficient	33%	30%
High	13%	10%

After implementing the experimental methodology, the results changed.

Changes in the Motivational Criterion

The motivational criterion characterizes the level of internal and external motivation for cognitive and research activity, students' initiative, interest in independent knowledge seeking, and aspiration for self-realization in physical education and sport.

Assessment indicators included:

- cognitive interest (interest in inquiry and experimental tasks);
- intrinsic motivation (awareness of research importance for personal development);
- independence and initiative in choosing topics and tasks;
- positive emotional attitude toward the research component of classes.

Each indicator was assessed on four levels: low (0–25 points), medium (26–50 points), sufficient (51–75 points), and high (76–100 points).

The comparative dynamics of motivational levels in the CG and EG are presented in Table 5.

Table 5

Distribution of students by motivational levels before and after the experiment (%)

Motivational level	*EG (before)*	*EG (after)*	*CG (before)*	*CG (after)*
High	10.0	43.0	13.0	16.0
Sufficient	30.0	44.0	33.0	36.0
Medium	40.0	10.0	40.0	36.0
Low	20.0	3.0	14.0	12.0

The data show pronounced positive changes in the experimental group. In particular:

- the proportion of students with a high level of motivation increased from 10.0% to 43.0% (a 33.0% increase);
- the number of students with a sufficient level rose by 14.0%;
- only 3% remained at a low motivational level.

In the control group, dynamics were less marked: a slight rise in the sufficient level (by 3.0%) and a marginal decrease in the low level (by 2.0%) were observed.

The Student t-test yielded a t-value of 3.36 ($p < .01$), confirming significant differences between the EG and CG after the formative phase. The results indicate that the pedagogical conditions embedded in the model effectively boosted students' motivation for inquiry and independent learning.

Changes in the Cognitive Criterion

The cognitive criterion reflects the level of knowledge required for cognitive and research activities in physical education and sport, as well as students' ability to apply this knowledge in practice. The main indicators were:

- volume and systemic nature of theoretical knowledge about methods of investigating physical phenomena and processes;
- understanding of the essence of experiments and the structure of the research process;
- analytical thinking and ability to generalize results;
- ability to transfer knowledge to new learning and practical situations.

Assessment used four levels: high (76–100 points), sufficient (51–75 points), medium (26–50 points), and low (0–25 points). The dynamics are presented in Table 6.

Table 6

Distribution of students by cognitive levels before and after the experiment (%)

Cognitive level	*EG (before)*	*EG (after)*	*CG (before)*	*CG (after)*
High	7.0	36.0	6.0	10.0
Sufficient	33.0	46.0	39.0	40.0
Medium	44.0	16.0	40.0	40.0
Low	16.0	2.0	15.0	10.0

There was a substantial increase in the cognitive component of engagement in the experimental group. The proportion of students with a high level rose from 7.0% to 36.0%, while the proportion of students with a low level decreased to 2%. The number of students with a sufficient level increased by 13.0%, indicating a qualitative enrichment of students' cognitive potential.

In the control group, positive dynamics were minor, with an increase in the high level of only 4.0% and essentially stable medium values.

The Student t-test ($t = 3.0$, $p < .01$) indicated statistically significant differences between EG and CG after the formative intervention.

The growth in cognitive readiness in the experimental group can be explained by:

- systematic integration of theoretical knowledge with practical research;
- the use of problem-based and inquiry methods;
- organization of mini-experiments and micro-projects that deepened understanding of theoretical principles;
- active use of digital analysis tools (heart-rate monitors, mobile apps, electronic logs).

Thus, students developed a holistic understanding of the research logic, improved planning and systematization skills, and enhanced their overall cognitive performance.

Changes in the Activity-based Criterion

The activity-based criterion captures the level of practical skills for organizing, planning, implementing, and analyzing cognitive and research tasks in physical education and sport. Indicators included:

- ability to plan the course of an experiment (aim, objectives, hypothesis, variables);
- skills in measuring, observing, and recording results;
- ability to analyze data and summarize results as conclusions;
- adherence to scholarly rigor and safety requirements during research tasks.

The four-level scale (high, sufficient, medium, low) was used again. Dynamics are presented in Table 7.

Table 7

Distribution of students by activity-based levels before and after the experiment (%)

Activity level	*EG (before)*	*EG (after)*	*CG (before)*	*CG (after)*
High	6.0	33.0	10.0	13.0
Sufficient	30.0	45.0	37.0	37.0
Medium	44.0	20.0	40.0	40.0
Low	20.0	2.0	13.0	10.0

The comparative analysis reveals significant growth in the activity-based component within the experimental group. The share of students at a high level rose from 6.0% to 33.0%, and the low level dropped to 2%. The proportion with a sufficient level increased by 15.0%, indicating the formation of stable practical skills for organizing research, planning experiments, and interpreting results.

In the control group, changes were insignificant, with a minor increase in the high level (3.0%) and essentially unchanged medium and sufficient levels.

Statistical analysis confirmed significant differences between EG and CG after the formative phase ($t = 2.25$, $p < .05$).

Positive changes in the experimental group resulted from:

- practically oriented research tasks (measurement of heart rate, speed–strength indicators, evaluation of training regimes);
- mini-projects involving independent data collection and analysis;
- small-group work that required interaction, role distribution, and joint result interpretation;
- the use of digital technologies for recording and visualizing results (electronic logs, monitoring apps).

This contributed to the development of independence, responsibility, accuracy, analytical capacity, and creativity in solving movement and learning tasks.

Changes in the Reflective Criterion

The reflective criterion characterizes students' ability to evaluate their own cognitive and research activities, recognize achievements and difficulties, and identify pathways for further self-improvement. Its main indicators were:

- awareness of one's learning achievements and problems;
- ability to analyze results and relate them to set goals;
- ability to plan further self-improvement;
- level of critical thinking and self-analysis.

The same four-level scale was used. Dynamics are shown in Table 8.

Table 8

Distribution of students by reflective levels before and after the experiment (%)

Reflective level	*EG (before)*	*EG (after)*	*CG (before)*	*CG (after)*
High	5.0	33.0	10.0	13.0
Sufficient	26.0	50.0	30.0	31.0
Medium	46.0	16.0	43.0	40.0
Low	23.0	5.0	18.0	16.0

These results demonstrate pronounced positive dynamics in reflective skills in the experimental group. In particular:

- the proportion of students with a high level of reflection increased from 5.0% to 33.0% (a 28.0% rise);
- the share at the sufficient level nearly doubled (from 26.0% to 50.0%);
- only 5% remained at a low level (a decrease of 18%).

In the control group, changes were minor and statistically insignificant.

The Student t-test (t = 3.36, $p < .01$) revealed significant differences between the experimental group and the control group.

The increased reflective level in the experimental group can be attributed to:

- the use of reflective essays, research diaries, and self-assessment questionnaires;
- group discussions of micro-project results, which stimulated peer assessment;
- the introduction of evaluation rubrics that included self-analysis criteria;
- final reflective sessions after each module (oral or written).

These strategies helped students develop critical awareness of their own activity, identify reasons for success and failure, and outline personal development paths.

The reflective criterion is integrative, combining motivational, cognitive, and activity-based aspects and enabling conscious self-regulation of learning and self-development.

Overall Dynamics of Cognitive and Research Engagement

To determine the overall effectiveness of the model, results for all four criteria were summarized. The combined dynamics in the experimental and control groups after the formative phase are presented in Table 9.

Table 9

Levels of cognitive and research engagement at the end of the experiment

Engagement level	*CG (end)*	*EG (end)*
Low	12%	3%
Medium	39%	15%
Sufficient	36%	46%
High	13%	36%

The experiment demonstrated a significant increase in cognitive and research engagement among students in the experimental group. The proportion of highly engaged students rose from 10% to 36%, while those at a low level decreased from 20% to 3%. This confirms the effectiveness of integrating cognitive and research methods into the teaching and training process. In the control group, changes in engagement were statistically insignificant.

The results are also illustrated in a diagram showing the distribution of engagement levels in both groups after the experiment (Figure 1).

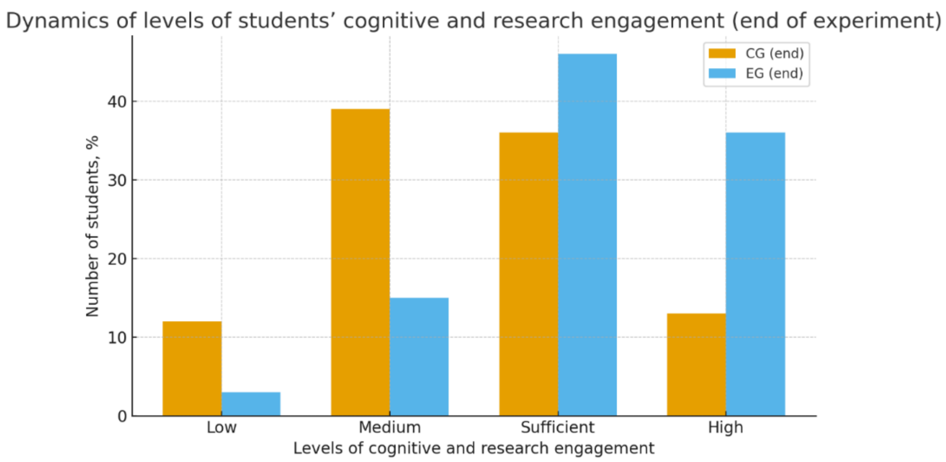

Figure 1. **Dynamics of cognitive engagement in control and experimental groups after the experiment**

The data are consistent with previous research (Jansson, 2022; Tacla & Ofrin, 2023; Sorensen, 2024), which indicates that students' active participation in research enhances motivation for physical education, supports self-control, and develops analytical skills. The use of digital technologies in teaching also had a positive effect on students' cognitive and research engagement. Incorporating research elements into physical education thus improves not only knowledge and skills but also strengthens students' active role as researchers of their own development.

Conclusions

The study enables the drawing of several theoretical and practical conclusions regarding the essence, significance, and effectiveness of cognitive and research activities in physical education and sport.

Cognitive and research activities in physical education are an important pedagogical tool aimed at developing intellectual engagement, independence, and reflection. It integrates the motor, emotional, and cognitive dimensions of personality, thereby supporting harmonious development.

The theoretical and methodological foundations of cognitive and research activities rest on activity-based, competence-based, learner-centered, and information–digital approaches. These approaches ensure the integrity of the process in which the student becomes an active subject of learning and research.

The pedagogical conditions for activating cognitive engagement include creating a motivational environment, supporting independence, using problem-based research methods, and developing reflective skills. The teacher plays a key role as a facilitator of inquiry.

The pedagogical model of research activity is realized through interactive technologies, digital monitoring tools, group and individual projects, and an assessment system that takes into account not only outcomes but also processes of inquiry.

Empirical results from the experiment confirmed the effectiveness of the methodology, as the level of cognitive and research engagement in the experimental group increased by approximately 20%, demonstrating the positive impact of research methods on motivation, analytical thinking, and self-organization in physical education.

The practical significance of the study lies in the possibility of applying the proposed approaches in physical education courses, sport and wellness activities, research clubs, and in the training of future physical education teachers. The findings underscore the need for a systematic shift from a reproductive model of teaching to one oriented toward students' research engagement and lead to several practical recommendations, in particular:

- educational programs should include a coherent research track that covers the basics of sport research and pedagogical experiments, methods for assessing physical condition and functional capacities, individual or group mini-studies, and public defense of research (mini-report, presentation, poster);
- curricula for specialists in physical education should incorporate components such as "Fundamentals of Sport Research", "Methods for Measuring and Monitoring Physical Condition", and "Digital Monitoring of Motor Activity";
- professional development for teachers should adopt a research-oriented paradigm, including training in sport pedagogy methods, the use of digital sensors and analysis software, the basics of statistics for pedagogical experiments, and methods for fostering cognitive engagement.

Overall, cognitive and research activity in physical education is an effective lever for modernizing the educational process. Its implementation contributes to the development of a holistic personality capable of self-awareness, critical thinking, and responsible attitudes toward personal health.

Future research should focus on developing models for the deeper integration of digital technologies into research activities and on designing systems of criteria for assessing research competencies in students from different specializations.

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