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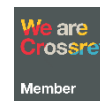
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The influence of nutritional status, physical fitness, and self-perception on student learning outcomes: a conceptual review

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ABSTRACT

Elementary physical education learning outcomes are often examined through isolated physiological or psychological variables, leading to fragmented theoretical explanations. This study aims to develop an integrated conceptual understanding of how nutritional status, physical fitness, and self-perception relate to learning outcomes in elementary physical education. A Conceptual Review was conducted using a narrative synthesis of national and international peer-reviewed literature published between 2018 and 2025. Relevant studies were analyzed to identify dominant conceptual patterns, theoretical positions, and relational mechanisms among the three constructs. The analysis indicates that nutritional status and physical fitness function as foundational physiological conditions, while self-perception operates as a central psychological mechanism mediating students' engagement and learning participation. Unlike previous research that treats these factors independently, this study proposes a unified conceptual framework that explains their interrelationships. This framework contributes to advancing holistic perspectives in physical education theory and provides a theoretical foundation for future empirical research and integrative educational interventions.



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Introduction

Physical education at the elementary school level is designed to support children's holistic development by integrating physical, psychological, and cognitive dimensions of learning. Contemporary educational frameworks increasingly emphasize that learning outcomes in physical education extend beyond motor skill acquisition to include students' engagement, confidence, and perceived meaning of physical activity (Bailey et al. 2019; Liu 2023; Valle-Muñoz, Mendoza-Muñoz, and Villa-González 2025). From this perspective, learning outcomes are understood as multidimensional processes shaped by students' physical readiness, psychological experiences, and

participation in instructional contexts. However, despite this holistic orientation, research on elementary physical education learning outcomes remains theoretically fragmented.

One of the most frequently examined determinants of learning outcomes in physical education is physical fitness. Prior studies consistently report that higher levels of cardiorespiratory and muscular fitness enhance students' ability to perform movement tasks and sustain participation during lessons (Z. Li et al. 2024; Li and Zhang 2025; Silva et al. 2024). Physical fitness is therefore often positioned as a direct predictor of learning success, particularly in performance-based assessments. Nevertheless, this perspective tends to emphasize observable performance while offering limited explanation of how physical capacity is translated into meaningful learning engagement among elementary school students.

Nutritional status represents another foundational factor influencing children's physical readiness for learning. Adequate nutrition supports energy regulation, growth, and physiological functioning necessary for sustained physical activity (Logue et al. 2018; Shao et al. 2021; Trijsburg et al. 2019). Empirical studies have shown that nutritional challenges, including undernutrition and unbalanced dietary patterns, are associated with reduced physical capacity and attentional control among school-aged children (Ansuya et al. 2023; Bommer, Mittal, and Vollmer 2020; Roberts et al. 2022). However, within physical education research, nutritional status is often treated as a contextual background variable rather than as an integral component of learning processes.

Beyond physiological conditions, psychological factors play a crucial role in shaping students' learning experiences in physical education. Self-perception, including perceived competence and physical self-concept, influences motivation, confidence, and willingness to participate in movement-based activities (Ensrud-Skraastad and Haga 2020; Pavlovic et al. 2025; Pulido et al. 2021). Research has shown that low self-perception is associated with avoidance behaviors and reduced engagement during physical education lessons (Cappello et al. 2025; Faella, Digennaro, and Iannaccone 2025; Sanchez-Matas et al. 2024; Zamorano-García et al. 2021). Despite its importance, self-perception is frequently conceptualized as an outcome of learning rather than as an active mechanism within the learning process.

Empirical evidence indicates that many elementary school students experience suboptimal physical education learning outcomes, reflected in declining physical fitness levels and inconsistent engagement in physical activity (Kliziene et al. 2021; Lee and Gao 2020; Polet et al. 2019; Tomkinson et al. 2017). These challenges are compounded by nutritional issues and psychological barriers, as well as limited awareness among educators regarding the interconnected nature of physical, nutritional, and psychological determinants of learning (Esdaile et al. 2024; Henrietta 2023). As a result, physical education outcomes often fail to achieve their intended developmental and educational objectives.

A critical limitation of the existing literature lies in the tendency to examine nutritional status, physical fitness, and self-perception as isolated predictors of learning outcomes. Studies focusing on physical fitness often overlook students' nutritional backgrounds or psychological readiness (Z. Huang et al. 2025; Ryder et al. 2017), while research on school nutrition frequently prioritizes academic achievement rather than physical education learning processes (Darling-Hammond et al. 2020; Mavilidi et al. 2018). Similarly, self-perception is commonly discussed within motivation research detached from physiological and health-related factors (Chew, Fernandez, and Shariff-Ghazali 2018; Robinson et al. 2020). This fragmented approach limits theoretical understanding of how these determinants interact dynamically within physical education contexts.

The need for an integrative conceptual perspective is further reinforced by global concerns regarding children's physical inactivity and health literacy. International reports emphasize the role of school-based physical education in counteracting sedentary lifestyles and promoting lifelong health behaviors (Bailey et al. 2022; Li et al. 2024; Santos et al. 2023). Nutritional education and physical fitness development are increasingly viewed as interdependent components of effective school health promotion strategies (Salmanov et al. 2025; Shahroodi et al. 2019; Tafuri, Tafuri, and Latino 2025). At the same time, fostering positive self-perception is recognized as essential for sustaining long-term engagement in physical activity (Chen et al. 2025; Ensrud-Skraastad and Haga 2020).

Positioned within this scholarly context, the present study conducts a Conceptual Review to clarify the theoretical relationships among nutritional status, physical fitness, and self-perception in elementary physical education learning outcomes. Rather than testing empirical associations, this study synthesizes theoretical and empirical literature to propose an integrated conceptual framework that emphasizes interaction and mediation processes (Kent et al. 2020; Schreiber and Cramer 2024). The novelty of this review lies in positioning self-perception as a central linking mechanism between physiological readiness and learning engagement. By offering a unified conceptual explanation, this study aims to advance holistic perspectives in physical education research and provide a foundation for future empirical investigation.

Method

Research Design

This study employed a Conceptual Review with a narrative conceptual analysis approach to examine the theoretical relationships among nutritional status, physical fitness, self-perception, and learning outcomes in elementary physical education. The study was positioned within an interpretivist paradigm, aiming to develop conceptual clarity and theoretical integration rather than to test empirical hypotheses (Salawu, Bolatitio, and Masibo 2023). A conceptual review was selected to enable critical synthesis, comparison, and reinterpretation of existing theories and empirical findings across disciplinary boundaries (Grant 2018). Unlike systematic or scoping reviews, this approach emphasizes analytical interpretation over comprehensive enumeration, making it suitable for multidimensional constructs spanning physiological, psychological, and pedagogical domains (Metsäpelto et al. 2022). The outcome of the analysis was the development of a theoretically grounded and conceptually transparent framework.

Conceptual Scope and Literature Selection

In this conceptual review, the population was defined as peer-reviewed scholarly literature addressing physical education learning at the elementary school level. The analytical sample consisted of national and international journal articles published between 2018 and 2025 that explicitly addressed at least one of the following constructs: nutritional status, physical fitness, self-perception, or physical education learning outcomes. Inclusion criteria required that studies (1) focused on elementary or primary school populations, (2) presented conceptual, theoretical, or empirical discussions relevant to physical education learning, and (3) offered definitional clarity or theoretical implications related to at least one target construct. Studies were excluded if they focused solely on academic achievement, adult populations, or non-school-based physical activity contexts. Literature selection was purposive and theory-driven, consistent with conceptual analysis methodologies in which texts function as units of analysis rather than participants (Chen et al. 2019).

Data Sources and Search Strategy

Data were drawn exclusively from secondary sources in the form of published journal articles. International literature was obtained from peer-reviewed journals in physical education, sport science, public health, and educational psychology, while national sources were selected from accredited Indonesian journals relevant to physical education research. Searches were conducted using academic databases commonly employed in educational research, including Scopus-indexed platforms and nationally accredited journal repositories. Key terms included combinations of “physical education,” “elementary school,” “nutritional status,” “physical fitness,” “self-perception,” and “learning outcomes.” Only articles published in English or Indonesian within the specified timeframe were included. Policy documents, textbooks, conference proceedings, and unpublished manuscripts were excluded to maintain conceptual and academic rigor.

Data Collection and Analytical Instrument

Data collection involved iterative reading, annotation, and conceptual mapping of the selected literature. The primary analytical instrument was a structured conceptual matrix developed by the authors to systematically extract key elements from each study, including construct definitions, theoretical frameworks, contextual assumptions, and proposed relationships among variables. The matrix facilitated consistency in data extraction and supported cross-study comparison. Rather than

serving as a measurement tool, the instrument functioned as an interpretive guide to minimize analytical drift and enhance transparency (Okan et al. 2018; Ries et al. 2022). Discrepancies in conceptual definitions across studies were documented and compared rather than resolved through exclusion.

Data Analysis Procedure and Trustworthiness

Data analysis followed a multi-stage interpretative synthesis characteristic of narrative conceptual reviews. First, core concepts were identified and categorized to establish conceptual boundaries and areas of convergence. Second, relational patterns among nutritional status, physical fitness, and self-perception were examined to determine whether these constructs were positioned as antecedents, mediators, or outcomes within physical education learning contexts. Third, recurring relational patterns were integrated into a unified conceptual framework emphasizing interaction rather than direct causality. To enhance trustworthiness, analytical decisions were guided by explicit inclusion criteria, iterative comparison across sources, and theoretical triangulation across disciplines. While subjectivity is inherent in conceptual reviews, transparency in analytical procedures supports reproducibility by future researchers employing similar criteria and analytical logic.

Methodological Limitations

As a conceptual review, this study does not aim to quantify effect sizes or establish empirical causality. The purposive selection of literature may introduce selection bias, and interpretations are contingent upon the theoretical perspectives emphasized in the reviewed studies. Nevertheless, by explicitly documenting analytical procedures and criteria, this study provides a coherent and replicable conceptual foundation for future empirical investigations.

Results and Discussions

This section presents the results of the narrative conceptual analysis through a synthesis of findings from previous studies related to nutritional status, physical fitness, and self-perception in elementary physical education. The results focus on identifying dominant patterns and conceptual tendencies rather than reporting empirical measurements. To provide an initial overview, the main findings from prior research are summarized in Table 1. This table highlights how each construct has been positioned within existing studies and reveals the degree of conceptual integration across research domains. Presenting the table at the beginning allows readers to grasp the overall structure of previous findings before engaging with the detailed narrative discussion. The subsequent subsections elaborate on these findings in greater depth.

Table 1. Summary of previous research findings on determinants of elementary physical education learning outcomes

Focus of Study	Main Findings	Conceptual Positioning
Nutritional status	Adequate nutrition supports physical readiness and participation in PE	Treated as background or contextual factor
Physical fitness	Higher fitness levels associated with better skill performance	Positioned as direct determinant
Self-perception	Positive self-beliefs enhance motivation and engagement	Often treated as outcome or separate construct
Integrated perspectives	Limited studies address interactions among variables	Conceptual integration remains underdeveloped

Note. Synthesized from selected national and international peer-reviewed studies (2018–2025) examining nutritional status, physical fitness, self-perception, and elementary physical education learning outcomes. Sources include: (Ladwig 2025; Mappaompo et al. 2020; Nidya, Kartini, and Suyatno 2024; Nugraha and Wibowo 2021; Osrita et al. 2020; Sánchez-Miguel et al. 2020; Sepriadi 2018; Sepriani et al. 2024; Silva et al. 2019; Zhu et al. 2022).

As indicated in Table 1, nutritional status is consistently recognized as a supporting factor for physical readiness in physical education but is rarely examined as a core component of learning outcomes. This pattern suggests that nutrition has been conceptually positioned as a background

condition rather than an integral determinant of physical education learning. The following subsection elaborates on how previous studies have addressed nutritional status and highlights the limitations of this perspective.

Findings on Nutritional Status and Physical Education Learning

Previous studies consistently indicate that nutritional status is associated with children's physical readiness and learning engagement in physical education contexts. Research from public health and school-based studies emphasizes that adequate nutrition supports energy availability and motor performance during physical activity (Nugraha and Wibowo 2021). However, most studies frame nutritional status primarily in relation to academic achievement rather than physical education learning outcomes (Osrita et al. 2020). Some physical education research acknowledges nutrition as a contextual variable but does not integrate it explicitly into learning models (Sepriadi 2018). This pattern reflects a tendency to treat nutritional status as an indirect determinant rather than a central learning-related construct. Consequently, its theoretical role in shaping physical education learning outcomes remains underexplored.

Findings on Physical Fitness and Learning Outcomes

Physical fitness has been the most extensively examined factor in relation to physical education learning outcomes. Numerous studies report that higher levels of cardiorespiratory and muscular fitness are linked to improved task performance and motor skill acquisition (Sánchez-Miguel et al. 2020). Fitness is often conceptualized as a direct determinant of learning success, particularly in performance-based assessments (Silva et al. 2019). Nevertheless, several studies adopt a narrow performance-oriented focus without considering motivational or psychological engagement (Sepriani et al. 2024). This dominant perspective limits the explanatory scope of fitness-based models. As a result, physical fitness is frequently discussed independently from broader learning processes.

Findings on Self-Perception in Physical Education

Research on self-perception highlights its importance in shaping students' motivation, confidence, and willingness to participate in physical education activities. Studies in educational psychology indicate that positive self-perception enhances persistence and reduces avoidance behaviors during learning tasks (Ladwig 2025). Within physical education contexts, self-perception is commonly examined through constructs such as perceived competence or physical self-concept (Nidya et al. 2024). However, these studies often position self-perception as an outcome rather than as a mediating mechanism between physical conditions and learning results (Mappaompo et al. 2020). Few studies integrate self-perception with physiological determinants such as nutritional status or physical fitness. This fragmentation underscores the need for a more integrative conceptual approach.

Comparative Synthesis of Previous Research Findings

Collectively, the reviewed studies reveal a fragmented approach to understanding determinants of physical education learning outcomes. Nutritional status, physical fitness, and self-perception are commonly examined within separate disciplinary frameworks. While physical fitness is frequently treated as a dominant determinant, nutritional and psychological factors receive limited conceptual integration. Only a small number of studies suggest potential interrelationships among these constructs without explicitly articulating their mechanisms (Zhu et al. 2022). In contrast to previous publications, the present study synthesizes these findings into a unified conceptual perspective. This synthesis highlights self-perception as a central connecting construct, distinguishing the current study from prior research.

The findings of this conceptual review clarify the theoretical relationships among nutritional status, physical fitness, and self-perception in shaping elementary physical education learning outcomes. Rather than viewing learning outcomes as the direct result of physiological capacity alone, this analysis supports a multidimensional interpretation in which learning emerges through the interaction of biological readiness, psychological engagement, and educational experience (Feng and Song 2025; Yijie, Zibin, and Lipowski 2024). This perspective responds to the study objective by moving beyond isolated predictors and offering a coherent conceptual explanation for learning processes in elementary physical education.

From a physiological standpoint, nutritional status and physical fitness provide essential conditions that enable students to participate in physical education activities. Nutritional sufficiency supports

energy regulation, growth, and attentional capacity during movement-based learning (Hargreaves et al. 2021; McGowan, Chandler, and Gerde 2024), while physical fitness enhances functional ability and task persistence (Kolovelonis and Goudas 2023; Wang et al. 2020). However, the present synthesis highlights that these conditions alone do not ensure positive learning outcomes, as students may remain disengaged despite adequate physical readiness.

Self-perception emerges in this review as a central psychological mechanism that mediates the translation of physical readiness into learning engagement. Prior studies demonstrate that children with sufficient fitness levels may still withdraw from learning when they perceive themselves as incompetent or experience low confidence (Cairney et al. 2019; Corr et al. 2018; Domville et al. 2019). Similarly, adequate nutritional status does not guarantee meaningful participation if students associate physical education with anxiety or perceived failure (Metz, Zander, and Hunger 2024; Sepriani et al. 2024). In this sense, self-perception functions as an interpretive filter through which physiological conditions are transformed into motivational and behavioral responses.

This conceptual positioning aligns with contemporary motivation theories that emphasize perceived competence as a core driver of engagement and persistence in learning (Ryan and Deci 2020). Unlike approaches that conceptualize self-perception primarily as an outcome of instruction, the present framework situates it as an active mediating process that dynamically interacts with physical conditions. This distinction helps explain why empirical studies often report inconsistent associations between physical variables and learning outcomes, despite similar levels of fitness or health among students.

In relation to existing international literature, the findings are consistent with global calls for holistic and systems-based approaches to physical education (Hill et al. 2018; L. Huang, Luo, and Yu 2025). Empirical interventions that combine physical conditioning with psychological support have been shown to foster more sustainable engagement than those focused solely on performance outcomes (Sun et al. 2025; Xu et al. 2024). However, the present study differs from outcome-oriented research by prioritizing relational mechanisms over prediction, thereby contributing a theoretical refinement rather than a methodological extension.

The conceptual integration proposed in this review has important implications for both research and practice. From a research perspective, the framework offers theoretically grounded propositions that can guide future empirical studies in examining mediational pathways among nutritional status, physical fitness, and self-perception without presuming direct causality (Celli 2022; Nguyen, Schmid, and Stuart 2020). For practitioners, the findings suggest that improving learning outcomes in elementary physical education requires coordinated attention to students' health conditions and psychological experiences, rather than isolated fitness-based or nutrition-focused interventions (Gruppen et al. 2023; Nemiro et al. 2022).

Despite its contributions, this study has conceptual limitations that should be acknowledged. As a conceptual review, the framework is shaped by the scope and perspectives of the reviewed literature and does not account for all contextual factors, such as instructional strategies, classroom climate, or sociocultural influences. Additionally, while self-perception is positioned as a central mechanism, other psychological constructs may also play important roles in learning processes. These limitations highlight the need for empirical validation and contextual refinement of the proposed framework.

Overall, this discussion underscores the value of integrative thinking in advancing elementary physical education scholarship. By articulating how physiological and psychological factors interact within learning processes, this conceptual review contributes to a more nuanced understanding of learning outcomes. Future research is encouraged to empirically test the proposed relationships across diverse educational contexts and to explore how instructional practices may strengthen the alignment between physical readiness, self-perception, and meaningful learning engagement.

Conclusions

This study concludes that understanding elementary physical education learning outcomes requires an integrative conceptual perspective that connects nutritional status, physical fitness, and self-

perception within a unified framework. By synthesizing previous research, the study advances the field by moving beyond fragmented, single-factor explanations toward a multidimensional interpretation of learning processes in physical education. The findings conceptually justify self-perception as a central psychological mechanism through which physiological readiness is translated into meaningful learning engagement. This contribution enriches existing knowledge by clarifying why improvements in physical or nutritional conditions alone may not consistently result in positive learning outcomes. The proposed framework provides a theoretical foundation that can inform more holistic educational planning and health-oriented physical education practices. Furthermore, the study offers a basis for future empirical research to examine mediational pathways and integrated interventions, thereby extending conceptual insights into practical and research applications.

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