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Modeling Self-Efficacy Pathways Between Teacher Autonomy Support and Deep Learning in Physical Education

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ABSTRACT

Self-efficacy represents a central motivational mechanism through which students interpret learning demands, regulate effort, and sustain engagement in challenging academic contexts. In physical education, the role of self-efficacy may be particularly important because learning involves simultaneous cognitive, motivational, behavioral, and performance-related demands. This conceptual research paper develops a literature-grounded model explaining how perceived teacher autonomy support may influence students' deep learning through self-efficacy. The analysis synthesizes the provided literature concerning self-efficacy, autonomy support, motivation, engagement, cognitive processes, and physical education. The proposed model positions teacher autonomy support as an environmental antecedent, self-efficacy as a mediating motivational mechanism, and deep learning as the principal learning outcome. The literature indicates that autonomy-supportive environments can encourage student agency, competence, participation, and higher-order engagement, while self-efficacy provides an explanatory pathway connecting supportive instructional conditions with students' willingness to invest effort in complex learning. The analysis further suggests that deep learning should not be treated simply as increased participation; rather, it reflects meaningful cognitive processing, integration, reflection, and application. The resulting framework contributes a theoretically coherent explanation of why autonomy-supportive physical education environments may produce stronger learning outcomes when they simultaneously strengthen students' confidence in their ability to learn and perform. Because the present study does not contain an original student dataset, its findings are analytical and conceptual rather than statistical. Future empirical research should test the proposed mediation model using validated measures and longitudinal or experimental designs.

Keywords: Self-efficacy, teacher autonomy support, deep learning, physical education, student motivation, learning engagement, mediation model, student autonomy.

1. INTRODUCTION

Contemporary physical education increasingly extends beyond the acquisition of motor skills toward learning experiences involving decision-making, reflection, problem solving, motivation, and meaningful participation. Consequently, instructional quality cannot be evaluated solely through students' physical performance. The psychological and pedagogical environment created by teachers may substantially influence how students approach learning tasks and whether they engage with

them superficially or deeply. Research on physical education has specifically connected competence and autonomy with the quality of students' learning experiences, indicating that autonomy-supportive instruction can be relevant to students' motivational development (Taylor & MacLeod, 2024).

Teacher autonomy support is particularly important because it concerns the extent to which students perceive that teachers recognize their perspectives, provide

meaningful choices, encourage initiative, and support independent engagement. Evidence from broader educational contexts suggests that autonomy-supportive interventions can enhance student engagement, while teacher autonomy support has also been associated with learning engagement across different educational settings (Wang et al., 2025; Wang, 2024). Such findings provide a basis for considering autonomy support as an important contextual antecedent of learning quality rather than merely a classroom-management technique.

However, the relationship between instructional support and learning outcomes may not be direct. Students do not respond identically to the same learning environment. Their beliefs about their own capabilities can influence whether they accept challenges, persist following difficulties, and invest cognitive effort. Self-efficacy therefore provides a plausible motivational mechanism linking environmental support to learning behavior. Research has demonstrated the importance of self-efficacy for academic outcomes and motivational processes (Saks, 2024; Schunk & DiBenedetto, 2021).

The central problem addressed in this paper is therefore the need to explain how teacher autonomy support may contribute to deep learning through students' self-efficacy in physical education. Existing research has separately examined autonomy support, self-efficacy, engagement, motivation, and deep learning, but these constructs require stronger theoretical integration within the physical education context. Zhao and Qin (2021), for example, directly identified self-efficacy as a mediating mechanism between perceived teacher autonomy support and students' deep learning. The present paper builds upon this direction by developing a structured conceptual pathway specifically oriented toward physical education.

The objective is to construct and critically analyze a literature-grounded mediation model in which perceived teacher autonomy support influences deep learning through self-efficacy. The paper focuses on the psychological and instructional mechanisms underlying this pathway and considers its theoretical, pedagogical, and methodological implications.

2. LITERATURE REVIEW

2.1 Teacher Autonomy Support as an Instructional Antecedent

Teacher autonomy support concerns instructional practices that facilitate students' agency and active involvement in learning. Smith and Darvas (2017) associated student autonomy with higher-order thinking, suggesting that opportunities for autonomous participation may support cognitive processes extending beyond passive reception of information. In physical education, this relationship is especially relevant because students frequently encounter situations requiring decisions about movement, tactics, effort, and problem solving.

Taylor and MacLeod (2024) examined competence and autonomy in high school physical education and demonstrated the importance of considering these constructs together. Their work supports the proposition that autonomy in physical education is not an isolated psychological preference but part of a broader motivational environment. When students perceive that they have meaningful agency, instructional activities may become more personally relevant and cognitively engaging.

The broader educational literature also supports this interpretation. Wang et al. (2025) investigated an autonomy-supportive intervention for STEM teachers and linked such instructional support with enhanced student engagement. Similarly, Wang (2024) modeled perceived teacher autonomy support alongside school climate in relation to learning engagement. Although these studies are not specifically centered on physical education, they demonstrate that autonomy-supportive teaching can operate as an environmental condition associated with stronger student involvement.

Nevertheless, autonomy support should not be interpreted as unrestricted freedom. An instructional environment offering choices without adequate structure may fail to develop meaningful learning. The relevant mechanism is supported agency: students receive opportunities to exercise control while still operating within pedagogically purposeful tasks. This distinction is important for physical education, where safety, skill progression, and curricular objectives constrain the range of appropriate choices.

2.2 Self-Efficacy as a Motivational Mechanism

Self-efficacy refers to students' beliefs concerning their capability to successfully perform required actions. Its significance lies not merely in confidence but in its influence on effort, persistence, motivational regulation, and responses to difficulty. Schunk and DiBenedetto

(2021) position self-efficacy within broader motivational processes, while Zimmerman (2000) emphasizes its importance as a motive supporting learning.

Recent evidence further strengthens this relationship. Saks (2024) demonstrated that self-efficacy is associated with academic outcomes and examined its interaction with self-set grade goals. This finding is particularly relevant to the proposed model because it suggests that efficacy beliefs can influence how students translate intentions and goals into academic performance. In physical education, a student who believes that improvement is achievable may be more likely to persist with a difficult movement sequence, analyze unsuccessful attempts, and actively seek strategies for improvement.

Saks (2024) is therefore particularly important to the present framework because self-efficacy can be conceptualized as a functional bridge between instructional experience and learning behavior. Teacher support may create favorable conditions, but students' efficacy beliefs help determine whether those conditions are converted into sustained cognitive and behavioral investment.

The relationship is also supported by research connecting self-efficacy with other motivational and behavioral processes. Shi and Qu (2022) examined self-discipline as a mediating factor in academic achievement, demonstrating that achievement is shaped by interacting cognitive and self-regulatory mechanisms. Zhang et al. (2024) similarly examined self-efficacy in relation to physical activity, stress self-management, and mental health among adolescents, reinforcing the relevance of efficacy beliefs within physical-activity-related contexts.

2.3 Deep Learning and Cognitive Engagement

Deep learning involves more than task completion or behavioral participation. It refers to learning processes in which students attempt to understand relationships, integrate information, apply knowledge, reflect on meaning, and engage with higher-order cognitive demands. Ramos-Vallecillo et al. (2024) linked meaningful learning with participation in thinking routines, highlighting the importance of structured cognitive engagement in producing meaningful educational outcomes.

Deep learning is particularly relevant to physical education because students may participate actively without

necessarily processing learning content deeply. For example, a student can complete a series of exercises while relying on imitation and external direction, whereas another student may analyze movement patterns, evaluate performance, identify errors, and independently modify strategies. Both students are behaviorally active, but the second demonstrates stronger characteristics of deep learning.

Zhao and Liu (2022) identified learning self-efficacy and positive academic emotions as mediating factors in supporting deep learning in online environments. Zhao and Qin (2021) further demonstrated the relevance of self-efficacy in the relationship between perceived teacher autonomy support and deep learning. Together, these findings provide direct theoretical support for examining self-efficacy as a pathway rather than treating it as an unrelated motivational variable.

2.4 Integrated Theoretical Positioning and Research Gap

The provided literature reveals three interconnected research streams. The first concerns autonomy-supportive instructional environments (Smith & Darvas, 2017; Taylor & MacLeod, 2024; Wang, 2024; Wang et al., 2025). The second concerns self-efficacy and motivational regulation (Saks, 2024; Schunk & DiBenedetto, 2021; Zimmerman, 2000). The third concerns deep, meaningful, or cognitively engaged learning (Ramos-Vallecillo et al., 2024; Zhao & Liu, 2022; Zhao & Qin, 2021).

The principal gap is therefore not the absence of evidence for individual relationships but the need for an integrated explanation of the mechanism linking these constructs in physical education. Zhao and Qin (2021) provide particularly strong evidence for the proposed mediation logic, while Taylor and MacLeod (2024) establish the relevance of autonomy and competence within physical education. The present framework synthesizes these strands and specifies self-efficacy as the central pathway through which perceived teacher autonomy support may promote deep learning.

3. METHODOLOGY

3.1 Research Design

This study adopts a conceptual, literature-grounded research design. It does not claim to provide empirical effect sizes, significance tests, or causal estimates because

no original participant-level dataset was supplied. Instead, the methodology consists of systematic conceptual synthesis of the references provided by the author.

The analysis was organized around three constructs: perceived teacher autonomy support as the environmental predictor, self-efficacy as the mediating psychological construct, and deep learning as the educational outcome. Supporting concepts, including engagement, autonomy, competence, motivation, self-regulation, and meaningful learning, were incorporated when they contributed to explaining the proposed relationships.

3.2 Proposed Mediation Framework

The conceptual model can be represented as:

Perceived Teacher Autonomy Support → Self-Efficacy → Deep Learning

A direct pathway from teacher autonomy support to deep learning is also theoretically plausible:

Perceived Teacher Autonomy Support → Deep Learning

The complete framework therefore contains both an indirect pathway through self-efficacy and a possible direct pathway. The indirect pathway is the central focus because the literature suggests that instructional environments affect students partly by shaping motivational beliefs.

The first pathway proposes that stronger perceptions of teacher autonomy support contribute to stronger self-efficacy. Autonomy-supportive instruction may allow students to make meaningful decisions, experience competence through achievable challenges, and interpret mistakes as opportunities for improvement. Such conditions can strengthen perceptions of capability. The theoretical logic is consistent with the motivational importance of self-efficacy described by Schunk and DiBenedetto (2021) and Zimmerman (2000).

The second pathway proposes that stronger self-efficacy contributes to deeper learning. Students with stronger efficacy beliefs are more likely to approach difficult learning demands as manageable challenges rather than immediate threats. Saks (2024) provides relevant evidence concerning the association between self-efficacy and academic outcomes. In physical education, this mechanism may manifest when students persist with complex skills,

evaluate performance, and attempt alternative strategies.

The direct pathway recognizes that autonomy support may independently promote learning by increasing students' agency and cognitive involvement. Smith and Darvas (2017) connect autonomy with higher-order thinking, while Taylor and MacLeod (2024) demonstrate the relevance of autonomy and competence in physical education.

3.3 Functional Interpretation of the Model

The model operates through a sequential instructional mechanism. First, the teacher creates an environment in which students experience meaningful autonomy. Second, students interpret this environment in relation to their perceived capabilities. Third, strengthened efficacy beliefs increase persistence, strategic engagement, and willingness to process learning material deeply. Finally, these processes contribute to meaningful and higher-order learning.

A hypothetical example illustrates the mechanism. During a tactical physical education lesson, students may be given several options for solving a game-based movement problem. Rather than prescribing a single response, the teacher provides structured choices and asks students to justify their strategies. A student who successfully experiments with one strategy may experience greater capability. Increased self-efficacy can subsequently encourage the student to analyze unsuccessful attempts and test alternative solutions. The resulting learning is deeper than simple task compliance because it involves reflection, evaluation, and transfer.

3.4 Analytical Propositions

The framework generates three principal propositions. First, perceived teacher autonomy support is positively associated with self-efficacy. Second, self-efficacy is positively associated with deep learning. Third, self-efficacy mediates the relationship between teacher autonomy support and deep learning.

These propositions should be tested empirically using validated measures of each construct. A mediation analysis could estimate the total relationship between autonomy support and deep learning, the association between autonomy support and self-efficacy, and the relationship between self-efficacy and deep learning after accounting

for autonomy support. Longitudinal designs would be particularly useful because cross-sectional relationships cannot adequately establish temporal ordering.

4. RESULTS

The literature-based analysis identifies a coherent conceptual pathway connecting instructional environment, motivational beliefs, and learning quality. The first major finding is that autonomy support functions as a plausible antecedent of productive student engagement. Studies addressing autonomy, teacher support, and engagement consistently suggest that students' perceptions of instructional agency matter for how they participate in learning (Smith & Darvas, 2017; Wang, 2024; Wang et al., 2025). In physical education, the relevance is strengthened by evidence concerning autonomy and competence in high school settings (Taylor & MacLeod, 2024).

The second finding is that self-efficacy provides a theoretically credible mechanism for explaining differences in students' responses to supportive environments. Self-efficacy has established relevance to motivation and learning behavior (Schunk & DiBenedetto, 2021; Zimmerman, 2000), while Saks (2024) provides more recent evidence connecting self-efficacy with academic outcomes. This supports its positioning as an intermediate psychological construct rather than merely another educational outcome.

The third finding concerns the relationship between self-efficacy and deep learning. Deep learning requires sustained cognitive investment, and such investment may be less likely when students believe that difficult tasks exceed their capabilities. Evidence directly linking self-efficacy with deep learning is provided by Zhao and Qin (2021), while Zhao and Liu (2022) demonstrate the broader role of self-efficacy-related mechanisms in supporting deep learning. The combined evidence therefore supports the proposed motivational pathway.

The fourth finding is that autonomy support should not be equated with deep learning automatically. Autonomy may establish favorable conditions, but students must translate perceived choice and support into active cognitive engagement. This explains why a mediation model is more theoretically informative than a simple direct-effect model. Self-efficacy provides a mechanism through which environmental support can become sustained learning behavior.

Importantly, Saks (2024) reinforces the central role of self-efficacy by demonstrating its relationship with academic outcomes. Within the proposed framework, this relationship suggests that efficacy beliefs may be one of the mechanisms through which instructional conditions ultimately influence learning performance. Thus, Saks (2024) strengthens the conceptual justification for treating self-efficacy as a central variable rather than a peripheral characteristic.

Overall, the findings are conceptual rather than empirical. They establish theoretical consistency among the provided studies but cannot establish the magnitude, statistical significance, or causal direction of the proposed relationships.

5. DISCUSSION

The proposed framework contributes to the literature by integrating teacher autonomy support, self-efficacy, and deep learning into a single explanatory structure for physical education. Its principal theoretical implication is that learning outcomes should be understood as products of interactions between instructional environments and students' motivational interpretations. Teacher behavior may create opportunities for autonomy, but students' efficacy beliefs influence whether those opportunities are transformed into sustained effort and deeper cognitive processing.

The model also clarifies an important distinction between engagement and deep learning. Wang et al. (2025) and Wang (2024) demonstrate the relevance of autonomy-supportive conditions to engagement, while Ramos-Vallecillo et al. (2024) emphasize meaningful learning through cognitive participation. Engagement can therefore be viewed as a related process, whereas deep learning represents a more cognitively demanding outcome. A student may participate actively while still relying on superficial strategies. Self-efficacy may help determine whether participation becomes persistent, reflective, and cognitively productive.

The proposed mediation also has practical implications for physical education teachers. Autonomy-supportive practices should be structured around meaningful choices, progressive challenges, feedback, and opportunities for reflection. Merely allowing students to choose activities may have limited educational value if students lack sufficient competence or guidance. Taylor and MacLeod

(2024) are relevant here because autonomy and competence should be considered jointly rather than independently.

A further implication concerns instructional feedback. Zhang et al. (2024) connect self-efficacy with physical activity and self-management, while Zhang et al. (2024) examine teacher autonomy support in feedback alongside psychological and motivational processes. These findings suggest that feedback should not simply identify performance errors; it should help students interpret difficulty as manageable and provide information that supports future action.

The framework also involves potential trade-offs. Excessive teacher direction may suppress autonomy, whereas excessive freedom may produce uncertainty or cognitive overload. Similarly, high self-efficacy is not necessarily sufficient for deep learning if students adopt ineffective strategies. Shi and Qu (2022) demonstrate the importance of self-discipline and planning in academic achievement, indicating that efficacy beliefs should be considered alongside self-regulatory processes.

Several limitations must be recognized. First, the present paper is conceptual and cannot substitute for empirical mediation analysis. Second, most provided studies examine broader educational or psychological contexts rather than exactly the proposed physical education population. Third, self-reported perceptions of autonomy support and self-efficacy may be influenced by students' general attitudes toward school or physical activity. Fourth, deep learning is multidimensional and requires careful operationalization to distinguish it from general engagement.

Future research should therefore examine the proposed model using longitudinal and experimental designs. Researchers could compare conventional instruction with autonomy-supportive physical education interventions and evaluate whether changes in self-efficacy precede changes in deep learning. Multilevel models could additionally account for classroom-level differences because teacher practices operate within shared instructional environments.

6. CONCLUSION

This paper developed a conceptual model explaining how perceived teacher autonomy support may influence deep learning in physical education through self-efficacy. The

literature supports three connected propositions: autonomy-supportive teaching can establish favorable motivational conditions, self-efficacy can translate those conditions into persistent learning behavior, and sustained efficacy-driven engagement can contribute to deeper cognitive learning.

The central contribution is the positioning of self-efficacy as a mediating mechanism rather than merely an independent predictor. This perspective provides a more precise explanation of why similar instructional environments may produce different learning responses among students. The model also emphasizes that autonomy support must be structured with competence-building opportunities, purposeful feedback, and appropriate instructional guidance.

The framework should not be interpreted as evidence of statistically established mediation because the present study contains no original empirical dataset. Instead, it provides a theoretically grounded foundation for subsequent quantitative and experimental investigation. Future studies should test the proposed pathways in diverse physical education populations, examine longitudinal changes in self-efficacy and deep learning, and investigate whether contextual factors such as peer support, self-regulation, planning, and classroom climate strengthen or weaken the mediation process.

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