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Peer Review

# Review of: "Why Is Physics Difficult? Some Reflections About the Cognitive Bases of Learning and Teaching Physics"

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This paper by Bagnoli et Gronchi offers a thoughtful and articulate exploration of the reasons why many students struggle to learn physics. Rather than focusing on external factors such as gaps in the educational and academic system, the authors adopt a cognitive perspective, examining the intrinsic mental demands of mastering physics concepts. They argue convincingly that the abstract and counterintuitive nature of physical laws—often far removed from everyday experience—requires a significant cognitive leap for learners, especially when intuitive notions formed from daily interactions with the world contradict formal physical reasoning.

One of the strengths of the paper lies in its nuanced discussion of mental models and how they affect the learning process. The authors point out that many students approach physics problems with deeply ingrained, experience-based assumptions (e.g., "heavier objects fall faster"), which are often in direct conflict with Newtonian or relativistic principles. The process of restructuring these internal models to align with scientific understanding demands not just new knowledge, but a reorganization of existing cognitive structures—an effort that is intellectually taxing and often emotionally frustrating for learners.

Furthermore, the paper raises important questions about the role of language and representation in physics education. By drawing attention to the multiple semiotic systems used in physics—mathematical notation, graphs, verbal descriptions, and diagrams—the authors illustrate how the translation between these systems can introduce additional barriers to understanding. This perspective is especially relevant for educators, as it underscores the need to be explicit and deliberate when guiding students through these representational shifts.

Finally, the work is notable for its meta-cognitive awareness. Rather than simply diagnosing the difficulty of physics as a static problem, the authors invite readers to reflect on the learning process itself,

 doi.org/10.32388/NVC2CP 

implicitly encouraging a more empathetic and learner-centered approach to teaching. While the paper remains largely theoretical, its implications for practical pedagogy are clear and thought-provoking.

This paper makes a meaningful contribution to our understanding of why physics can be a cognitively demanding subject. The reflections offered by the authors are both insightful and applicable, making this work valuable reading for educators and researchers aiming to improve physics teaching and learning.

The inclusion of empirical data or case studies would strengthen the theoretical claims. A deeper exploration of individual learner differences (e.g., skills, specialization, prior knowledge) could enrich the cognitive analysis.

## Declarations

**Potential competing interests:** No potential competing interests to declare.