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Original Paper

The Dilemma of Teaching Physics

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Abstract

In contemporary education, a striking paradox has emerged: while society increasingly celebrates technological innovation, artificial intelligence, and robotics, many students demonstrate disengagement from the exact sciences, particularly mathematics, physics, and chemistry. This disconnection poses a significant challenge, as technological advancement continues to depend on human reasoning and scientific understanding.

Two principal factors help explain this phenomenon.

First, the incremental and historically linear presentation of scientific knowledge often fragments learning and obscures the interconnectedness of physical principles. As secondary education frequently halts before reaching topics perceived as relevant, students struggle to perceive meaning or coherence in scientific study.

Second, the affective dimension of learning has gained central importance. Today’s students, shaped by digital media environments such as YouTube, TikTok, and Instagram, demand emotional engagement and dynamic, condensed information. Traditional, abstract instruction fails to meet this cognitive and cultural profile. Digital pedagogy can partially bridge this gap by introducing interactive tools, online simulations, and gamified assessments to enhance engagement. However, a deeper pedagogical reorientation is necessary—one that humanizes physics and connects it to lived experience. By relating physical concepts, such as thermodynamic efficiency, to personal growth and individuality, educators can make science emotionally resonant and personally meaningful. Integrating technical understanding with humanistic reflection may reawaken students’ curiosity, reaffirming the enduring relevance of the exact sciences in shaping both technology and human development.

Complete paper

In contemporary discourse with high school students, a recurring question emerges: what underlies the widespread disengagement of young people from the exact sciences? Paradoxically, in a society that increasingly valorizes technologization, artificial intelligence, and robotics, a substantial proportion of students exhibit aversion toward mathematics, physics, and chemistry.

This paradox becomes particularly evident when considering that the development of new technical solutions and the curation of databases still depend fundamentally upon human intelligence. The central challenge, therefore, lies in persuading today’s youth of this enduring reality.

From my perspective, two principal factors—although by no means exhaustive—account for this phenomenon.

1. **The incremental presentation of knowledge**. Physics instruction typically mirrors the historical trajectory of the discipline, introducing concepts sequentially and often in isolation. A profound comprehension of complex physical phenomena, however, presupposes mastery of foundational elements and the cultivation of a logical framework through which information may be interconnected. Yet, secondary-level curricula frequently terminate at the exposition of phenomena that lack immediate perceived relevance to the majority of students.

2. **The affective dimension of learning**. Contemporary students display an acute need for emotional engagement. The rigid and abstract delivery of physics concepts appears misaligned with this demand,

rendering the discipline less compelling.

These causes can be traced to the broader cognitive and cultural profile of today's youth. They prefer highly condensed, dynamic information, seldom sustaining attention on a single topic for more than twenty minutes—a pattern shaped by their immersion in digital media such as YouTube, TikTok, and Instagram. These platforms deliver vivid, self-contained content within seconds, circumventing ancillary details and simultaneously eliciting emotional responses.

Digital pedagogy offers valuable instruments to address these challenges, equipping educators with interactive tools—ranging from online simulations and virtual experiments to gamified assessments—that may enhance lesson attractiveness.

Nevertheless, a more fundamental reorientation of approach is warranted. Physics should not be confined to the mechanistic explanation of technologies such as televisions or automobile engines. It equally encompasses the functioning of the human body and, more broadly, the dynamics of human interaction within society.

Consider, for example, the pedagogical potential of thermodynamic efficiency. Explaining to students that no engine can achieve an ideal efficiency of 100 percent, and that each engine possesses a unique maximum attainable under optimal conditions, may captivate those interested in mechanical systems. More importantly, this concept can be transposed metaphorically to human development: by virtue of our unique genetic codes, we each possess distinct abilities whose optimal realization depends upon cultivation. In this sense, interpersonal comparisons—common in educational settings—are as inapt as comparing engines with differing characteristics.

This is issued that young people face—comparing themselves to their peers—stems from a misguided approach to the idea of competition and can, for some of them, lead to trauma. A model of presenting performance in physics such as this, can help them understand the futility of competition within a heterogeneous classroom, where only a few elements are shared. Competition should therefore be redirected to another level, namely, first and foremost to the personal level, toward achieving one's maximum potential.

We can also change our approach when we formulate problems: instead of presenting them as "a particle falls from a height h," we might say, for example, "While trying to catch a sparrow, a cat falls from a height h; because it has nine lives, it suffers no harm. However, we can still calculate the velocity with which it hits the ground."

Such an approach evokes an emotional response, while the expression must remain relevant.

Physics has the advantage of revealing the properties of matter and phenomena that we can interpret at the social and relational level. Since young people need to express emotions and, even more, to validate what they feel, they will be far more engaged if we bring physical phenomena into the interpersonal sphere.

Concepts such as energy or mechanical power can easily be transposed at this level.
Young people will feel much more comfortable understanding that the expression "a person full of energy, accomplishing various things" is precisely what physics teaches: a system that has energy can perform mechanical work.
The beauty lies in the fact that in physics we can calculate how much mechanical work can be produced, depending on the initial energy and the conditions of the system.

Similarly, the potential of a field corresponds to what in everyday life we call the ability to undertake an action or to perform a task.

Examples could go on, and I am confident that every teacher can find new approaches

In describing physical phenomena, countless examples can be provided in which purely technical concepts are addressed not only from a technical perspective—supported by short virtual demonstrations or even laboratory experiments—but also by transposing the information to the human level, thereby eliciting emotional engagement and bringing physics into a more human, personal dimension.

However, the underlying idea remains to enliven the concepts taught, bringing them not only into the technical and scientific realm but also into the human one.
Such an approach, centered on what young people feel, offers them a validation of their own experiences and emotions.

We live in a society in which outward appearance is extremely important—especially for young people—where their validation comes predominantly from comparison with models presented in the mass media. Those who fail to reach these standards, or who do not identify with them, develop frustrations and real difficulties in understanding themselves or in socializing. Explaining physical, chemical, or biological phenomena at an interpersonal level—emphasizing the normality of imperfection, of having unsuspected potential, of using one's energy to produce mechanical work that propels them forward on the evolutionary scale—can offer young people another facet of the validation they long for.

Science can help them understand in depth the uniqueness of each of us, and that to feel fulfilled we simply need to discover the areas in which we can come closest to achieving our maximum performance.

Another equally important issue is young people's tendency to avoid in-depth study based on personal research and discovery. Any new topic presented to them becomes tiring if the path from premises to conclusion is not short enough, and their solution often becomes solving the problem with the help of artificial intelligence.

I carried out the following experiment with a class of 15–16-year-old students. I presented them with the title of a new lesson and only a few words about what we were going to study.
I then asked them to draw a two-column table in their notebooks. In one column they were to write everything they considered necessary for understanding the new concepts, using ChatGPT to assist them. After the allotted time had passed, I taught the lesson myself, and they wrote the new concepts in the other column.

At the end of the lesson, I let them compare the two columns, and we discussed why there were such large differences between what they had written and what I had explained.

The joy they felt at being allowed to use their phones openly during class and to work with ChatGPT made them much more receptive to acquiring new information.

The conclusions were extremely valuable, because they understood:

– how important it is to distinguish the essential from the nonessential;

– how to ask the right question (creating correct prompts);

– the need to have a solid minimum of prior knowledge in order to understand a new subject correctly.

As I repeated the experiment with the same students, they became increasingly attentive to collecting information and asked me more preliminary questions—unlike the first time, when they asked none at all, convinced that they could understand something entirely new with the help of artificial intelligence alone.

In my view, this combination of the teacher's contribution and artificial intelligence is useful for the next stage of their intellectual development, but for the 14–18 age group emotional involvement becomes essential—something that can only be provided by a teacher willing to see science as an integrated whole that helps young people to know themselves in a social context and, of course, within the context of the natural phenomena that define us as human beings.

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