Preliminary Title: LLMs in a New Pedagogical Era

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1.   Beyond Standardisation

My journey toward this project began with a question: how could large language models change the way we think about programming, and more specifically, about teaching it? This question first took shape over a year and a half ago, when LLMs had grown powerful enough to be intriguing, yet still fell short of reliably handling complex programming and development tasks. Even at that early stage, one thing was clear: if LLMs were to be integrated into education, the way we teach and learn would have to evolve. But how?

Around the same time, I revisited the work of John Dewey on project-based learning. Dewey's insights into learning through meaningful, student-driven activity resonated strongly. While his ideas have been widely debated and adapted over the years, the foundational principles—learning by doing, reflecting, and engaging with real problems—remain compelling.

I do not claim that project-based learning is a panacea for all educational challenges. It might not even be dominating. Yet, in the context of integrating LLMs into programming education, it offers a promising framework to explore, experiment, and rethink what learning can be.

In what follows, I will exaggerate—but deliberately so, in order to highlight a point. The caricature I present is not meant to be a precise depiction; rather, it creates a contrast that can help us see underlying patterns more clearly. Even if the caricature itself is imperfect, the contrast it draws may be revealing. After all, most teaching today is a complex blend of pedagogical approaches, a mixture of methods and assumptions that rarely fits neatly into a single category.

Introduction

The modern school system rests on structural assumptions so deeply embedded that they rarely go questioned. Students sit in neat rows; instruction flows from a central authoritative source; learning is broken into fixed units; evaluation proceeds via predefined tests. On the surface, this uniformity conveys equity—all students receive the same input and are judged by the same measures. In reality, however, the consequences are far from neutral.

This uniform structure transforms schooling into a competitive field; yields only probabilistic evidence of learning; and limits educational possibilities to what can be predetermined.

This chapter explores an alternative grounded in divergent, student-driven projects influenced by the educational philosophy of John Dewey. It argues that competition arises from comparability, comparability arises from standardisation—and that by abandoning the assumption that all students must learn the same things via the same tasks, we remove the very conditions that produce competitive pressure. Instead, we propose an educational structure in which skills are demonstrated directly through practice rather than inferred

from tests. The shift is from an educational logic of prediction to one of proof.

In the sections that follow, the argument is developed analytically, practically, and philosophically.

1.0.1. The Competitive Logic of Standardised Schooling

Uniformity as a Hidden Design Choice

In the traditional classroom model, the key structural features are:

- Uniform instruction
- Uniform curriculum
- Uniform testing

These features are often defended under the banner of equality—the idea that everyone should have the same opportunity, the same input. But uniformity is not a neutral default: it is a specific design choice with predictable consequences.

Here is the chain of implications:

- Uniform instruction –> Predictable outcomes
- Predictable outcomes –> Common tasks
- Common tasks –> Comparability
- Comparability –> Ranking
- Ranking –> Scarcity of recognition / reward
- Scarcity –> Competition

In other words: when twenty students take the same test at the same time, the test becomes the mechanism that orders them along a single scale. The classroom becomes implicitly a competitive field, regardless of whether the instructor intended competition. The structure itself produces competition.

Tests as Probabilistic Measurements

Standardised tests rarely measure what a student can do in the fullest sense. Instead, they sample a domain of potential competence. A student might perform well on a mathematics exam, suggesting they likely have certain mathematical skills. A student who fails might or might not lack those skills—tests do not eliminate that ambiguity.

Thus conventional assessment yields probabilities, not certainties. It is a system of inference, not demonstration. While this may be efficient for administrative purposes—ranking, certification, selection—it is weak if the goal is to truly assess capability or competence.

1.0.2. Dewey's Alternative: Learning Through Meaningful Activity

Learning as Situated and Experiential

John Dewey challenges the assumption that education must begin with abstract content and uniform instruction. Instead, he sees learning as emerging from experience, inquiry, and meaningful activity. For Dewey, the classroom ideally resembles a site of real-world engagement, where students learn by doing, reflecting, and redoing—not simply by memorising and reciting.

Under this view, knowledge is not simply transmitted; capacities develop through participation and interaction. Learning becomes fundamentally situated: embedded in context, connected to purpose, and shaped by experience.

Competence as Demonstrable

If knowledge arises through action, then competence becomes demonstrable, not merely inferred. Students show what they can do by doing—by building, experimenting, designing, creating, analysing. This moves evaluation away from abstract tests toward concrete evidence.

In such a model, success is not measured by how well a student recalls definitions or solves artificial exercises under time pressure. Rather, success is measured by what the student can produce: a model, a prototype, an experiment, a design, a written analysis, a documented project.

This reorients the educational goal: from memorising content to cultivating abilities; from preparing for tests to preparing for real-world tasks.

1.0.3. Divergent Projects as an Educational Architecture

From Uniform Tasks to Heterogeneous Pathways

If students are allowed—or encouraged—to work on different projects, each aligned with their interests, backgrounds, and motivations, the structure of schooling changes radically.

In a divergent project system:
- There is no single assignment that every student must complete
- Projects vary in purpose, tools, difficulty, method, timescale, and expected outcome
- Students exercise choice and agency

Under those conditions:
- Comparability collapses—tasks and outputs are too heterogeneous to rank meaningfully
- Structural competition dissolves—there is no shared "single peak" to compete for

Thus the system becomes non-competitive, not because competition is banned, but because its structural preconditions no longer obtain.

Curriculum as "Possible Skills" Rather than "Required Outcomes"

In a divergent project curriculum, one cannot realistically require all students to acquire the same set of skills. Instead, the curriculum should define domains of possible skills—for instance, research, design, analysis, modelling, collaboration, communication, documentation.

Each project engages a different subset of these domains, and students acquire according to the demands of their project.

This respects Dewey's principle: learning grows from the needs and challenges of purposeful activity, not from abstract, predetermined content lists.

Assessment Through Proof Rather Than Prediction

Under this model, the primary evidence of learning is the project itself:
- A built artefact—physical or digital
- A working simulation or design
- An experiment or data collection
- A written or multimedia analysis
- Documentation of process—logs, journals, revisions

These are not proxies. They are direct, situated demonstrations of competence.

For example:

- A student constructing a working water-filtration prototype demonstrates understanding of fluid dynamics, design constraints, material properties, and perhaps teamwork and project planning.
- A student producing a documentary shows research ability, narrative structuring, technical media skills, and critical thinking.
- A student writing a physics simulation embodies modelling skill, algorithmic thinking, coding ability, and conceptual clarity.

There is no need for inference or probability. The question is not "what the student might know" but "what the student can do." Assessment becomes a matter of proof, not prediction.

1.0.4. Philosophical and Political Implications

Dewey: Education as Growth Within a Community

For Dewey, education is not a preparation for life—it is life. A classroom based on meaningful, collaborative projects mirrors the conditions of democratic society: inquiry, problem-solving, cooperation, communication, shared purpose.

Divergent projects allow individual variation, creativity, curiosity, and identity formation. They respect the diverse capacities and interests of learners. Education becomes a communal endeavour of growth, not a conveyor belt of uniform outputs.

Institutional Critique: Beyond Certification

Other thinkers (for example, echoing the arguments of Ivan Illich and Gert Biesta) warn that institutionalised schooling often conflates certification with competence. Standardisation tends to privilege conformity over competence; testing becomes a ritual rather than a genuine evaluation of capability.

Divergent project work undermines this conflation by foregrounding actual competence through tangible work. It also aligns with models of learning as networked, resource-based, learner-driven—rather than institutionally imposed.

Education thus becomes not merely about credentials or ranking, but about real capacities, meaningful participation, and personal growth.

The Three Functions of Education

According to Biesta, education serves three functions:

- Qualification—acquiring knowledge and skills
- Socialisation—becoming part of a cultural and social community
- Subjectification—becoming an autonomous, responsible individual

Standardised schooling heavily privileges qualification; often at the expense of socialisation and subjectification.

Divergent project-based learning supports all three:

- Qualification: through demonstrable project competence
- Socialisation: through collaborative projects, dialogue, shared inquiry
- Subjectification: through student choice, agency, responsibility, reflection

The result is a more holistic, human-centred education.

1.0.5. Practical Concerns—Limits, Challenges, and Hybrid Solutions

The Role of Foundational Knowledge

A common objection: some fields—mathematics, physics, languages—involve conceptual load and cumulative structure. Novices may struggle if given only open-ended projects without prior instruction. Cognitive science suggests that particularly for beginners, guided instruction and scaffolding significantly improve learning outcomes.

Therefore, a fully Deweyan, pure project-only model may fail in foundational stages or in domains requiring mastery of underlying abstractions.

Risk of Inequity and Uneven Opportunity

If projects are entirely open and student-driven, differences in background, resources, prior exposure, motivation, or socio-economic context may produce uneven learning outcomes. Some students may thrive; others may flounder without structure or support. This could exacerbate inequality rather than mitigate it.

Assessment, Accountability, and Institutional Constraints

Traditional institutions (schools, districts, universities) rely on standardised metrics for accountability, reporting, comparability, and progression. Divergent project-based assessment is harder to standardise, compare, or aggregate. It may be viewed as subjective or inconsistent from an institutional perspective.

A Hybrid Approach: Combining Explicit Instruction and Divergent Projects

Given the strengths and weaknesses of both models, a hybrid approach appears viable:
- Use explicit instruction and structured guidance to build foundational knowledge and basic skills.
- Then transition into divergent, student-driven projects for application, creativity, reflection, and demonstration.

This combines the efficiency of direct instruction (especially for novices and conceptually dense domains) with the richness, authenticity, and human-centredness of project-based work.

It also allows institutions to meet both accountability requirements and educational goals of autonomy, creativity, and competence.

1.0.6. Conclusion

The dominant paradigm of standardised schooling—uniform instruction, uniform tasks, uniform testing—carries hidden but powerful effects. It generates comparison, ranking, competition; reduces learning to probabilistic measurements; and limits educational possibility to what can be predetermined.

By contrast, a model grounded in divergent, student-driven projects, informed by Deweyan philosophy, offers a radically different logic. In such a model:
- Students engage in meaningful, situated activity;
- They acquire skills in response to real tasks, not arbitrary assignments;
- They demonstrate competence through concrete artefacts and processes—proof, not probability;

- They participate in collaborative, communal, creative inquiry;
- They grow as individuals with agency, purpose, and reflected identity.

This shift is more than pedagogical. It reimagines what education is for: not the reproduction of predefined outcomes, but the cultivation of beings capable of inquiry, creativity, cooperation, and growth in a complex world.

Adopting this model does not require rejecting structure or foundational instruction—but it does require redefining success, assessment, and the purpose of schooling itself.

In doing so, we align education more closely with human flourishing, democratic living, and genuine competence.