Binary Machines, Quantum Playgrounds? On the Transformational Potential of Aesthetic-Epistemic Intervention

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Author: Zrinka Štimac

Leibniz-Institut für Bildungsmedien | Georg-Eckert-Institut

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Binary Machines, Quantum Playgrounds? On the Transformational Potential of Aesthetic-Epistemic Intervention

Zrinka Štimac

Abstract:

What kind of reality do our language machines draw us into? Binary language models are not neutral: they tend to reproduce substantialist worldviews, even when explaining quantum physics. This article argues that aesthetic and pedagogic intervention can reshape these defaults. Drawing on Cassirer, Barad, and Bohr, it presents Symphony of the Spheres — a co-creative epistemic artifact developed with AI that translates names, historical numerological systems, and color theories into context-dependent tunes. The result is a performative instrument for quantum-relational thinking: non-linear, contextual, participatory. Binary machines, it turns out, can be cracked open.

1. Binary machines cracking open

On the cusp of the quantum age, everything vibrates more intensely, more dangerously, more inspiringly. We work with binary language models that operate with numbers and statistical probabilities formulated by humans and are trained on huge corpora of human language and logic. They predict the next character and the next word. They use binary combinations to generate content that we may like or not. By now, they are also routinely deployed in contexts of conflict and warfare.

They have become a new building block in the field of symbolic forms[1] such as language, art, science, myths and are simultaneously reshaping cultural meaning. Their mode of operation is definitely not superimposed or entangled. They simulate uncertainty but remain grounded in deterministic binarity. They reproduce everything they have been given to process, thereby repeating and stabilizing it.

How can they be used as a quantum playground? This paper presents an example of this kind of play.

2. What is hidden in a plane site (and in plain sight)?

As we know, LLMs are neither neutral nor objective machines, despite all the efforts of their manufacturers. When they serve as educational media to answer students' questions about quantum technologies, generate explanations, and provide examples, they convey worldviews: whether reality consists of separate, stable

[1] Cassirer, E. (1923–1929). The Philosophy of Symbolic Forms. Yale University Press.

objects (substantial ontology), or whether we and the world are fundamentally relational, emergent, and co-constituted (quantum relationality, ontological designs).[2] Crucially, quantum-relational thinking differs from classical relationality: where the latter connects pre-existing entities, the former insists that entities themselves emerge through relation: there is no A before the encounter with B.[3]

My research on quantum technology in German school textbooks and youth non-fiction reveals a certain pattern.[4] When it comes to quantum technology, educational media implicitly raise fundamental questions: What is reality? What does observation mean? However, they offer little guidance on how young people can process quantum-relational questions and integrate them into a coherent worldview. In other words, ontological anchoring of this relational worldview is missing.

Students learn that the quantum world is "counterintuitive," "beyond common sense", and even "strange". The relational, nonlinear thinking skills that would be required in this context are rarely promoted.[5] Quantum physicists themselves reflect this.[6]

Parallel to this, LLMs naturally reproduce these positions. When asked to explain quantum mechanics, many models default to classical metaphors: strange rules of quantum physics, particles as billiard balls, superposition as "being in two places at once." Only when challenged with irritating or rather, inspiring prompts do they open up to other ways of interpreting the subject.

But if we assume that knowledge and being are intertwined, and that observers and the observed bring each other into being[7], then we can see the bigger picture. For art of all sorts already embodies the relational thinking that is so urgently needed for the quantum age.

What is missing is reinterpretation of quantum technologies as invitations to quantum-relational thinking. All this means that our new task is to teach not only students but also LLMs how to play quantum glass bead games.

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[2] Willis, A.-M. (2006). Ontological designing. Design Philosophy Papers, 4(2), 69–92. https://doi.org/10.2752/144871306X13966268131514; Escobar, A. (2022). Designs for the pluriverse. DIID, 1(75). https://doi.org/10.30682/diid7521d

[3] Štimac, Z. (forthcoming 2026). New Humans, New Thinking? Quantum Literacy and Future Education. Journal on AI Policy and Complex Systems.; Cf. also Štimac, Z. (2024). In Search of Lost Relations: Educational Approaches in the Light of Quantum Mechanical Equivalents. Journal on AI Policy and Complex Systems, 9(1). https://doi.org/10.18278/jpcs.9.1.3

[4] See project: https://www.gei.de/en/research/projects/neue-menschenbilder-neues-denken-quantentechnologie-als-herausforderung-der-bildung (funded by *zukunft.niedersachsen*)

[5] Examples from educational media: Cornelsen's Universum Physik (2024, p. 265) instructs students to calculate the de Broglie wavelength for Usain Bolt's world record (95 kg, 100m in 9.58s): Here quantum formalism is applied as calculation exercise, without ontological reflection. Baur, M. (2020). Licht und Atome. Tessloff: the world of quanta is a strange one (p. 4), crazy particles (p. 22) — wonder without grounding.

[6] Barad, K. (2007). Meeting the Universe Halfway. Duke University Press.; Bohm, D. (1980). Wholeness and the Implicate Order. Routledge.; Rovelli, C. (2021). Helgoland. Penguin.

[7] Wheeler, J.A. (1983). Law Without Law. In Wheeler & Zurek (Eds.), Quantum Theory and Measurement. Princeton University Press.; Barad, K. (2007), each in a different way.

3. *Symphony of the Spheres*: An aesthetic-epistemic intervention

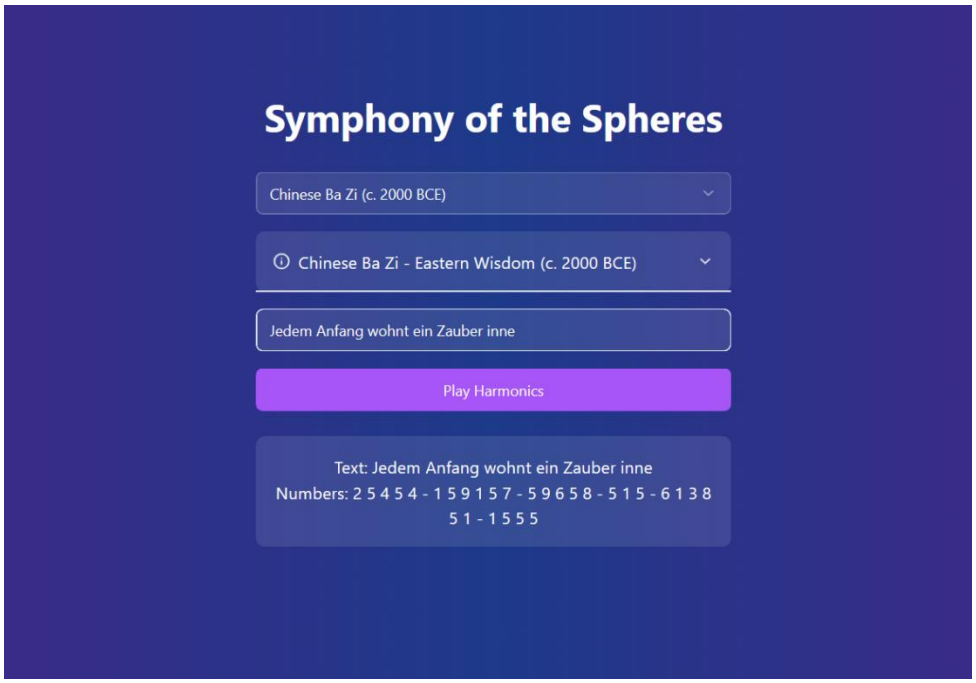
How does a name sound across human history? I developed *Symphony of the Spheres* to find out: it combines letters, numbers, tones, and colors. Each letter has a numerical equivalent, while numbers correspond to tones (frequencies). Every era, every culture had its own keys for this convergence.

With the support of AI coding assistant lovable.dev, this idea became reality. I provided the concept and infrastructure: links to harmonic systems, letter-number correspondences in Gematria and Chinese cosmology, tone-frequency assignments. The AI offered further historical examples as well as Newton's color theories as a sensory level extension. Later, I added Goethe's color theory as a cultural artifact.

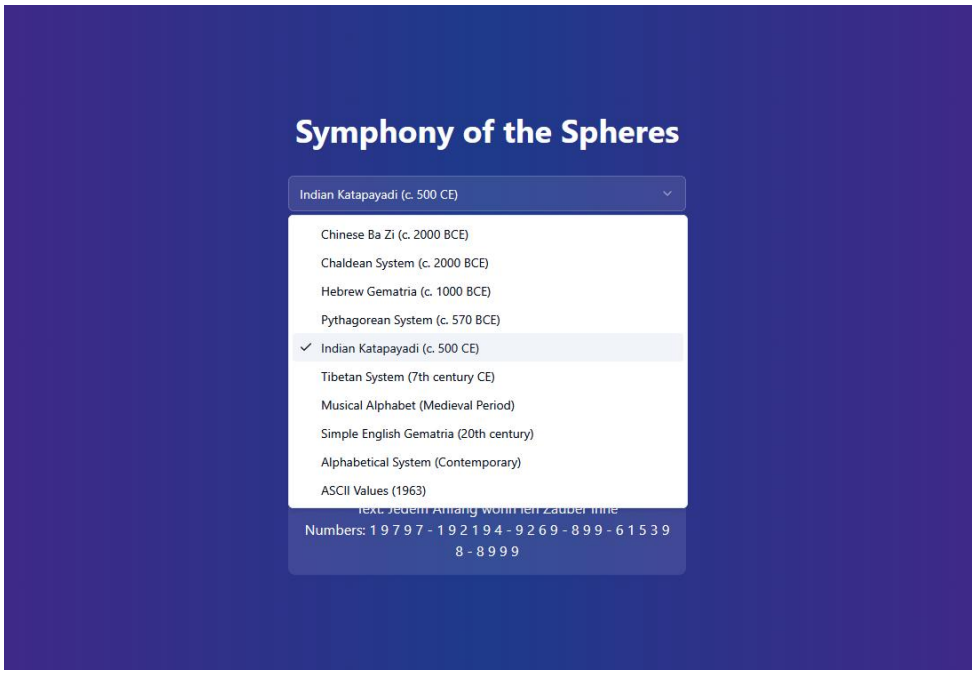
Symphony of the Spheres enacts interconnectedness, emergence, complementarity, participation in content, structure, and method alike. Learners enter it, and in doing so become co-creators of the knowledge and meaning that emerge. What results is not solely a didactic instrument, but a performative epistemic artifact where knowledge is experienced as relation, resonance, and response.

From a philosophical perspective, this represents a convergence of symbolic forms as Cassirer conceived them. From an educational perspective, it enacts what Bohr emphasized: complementarity not as paradox, but as epistemic principle.

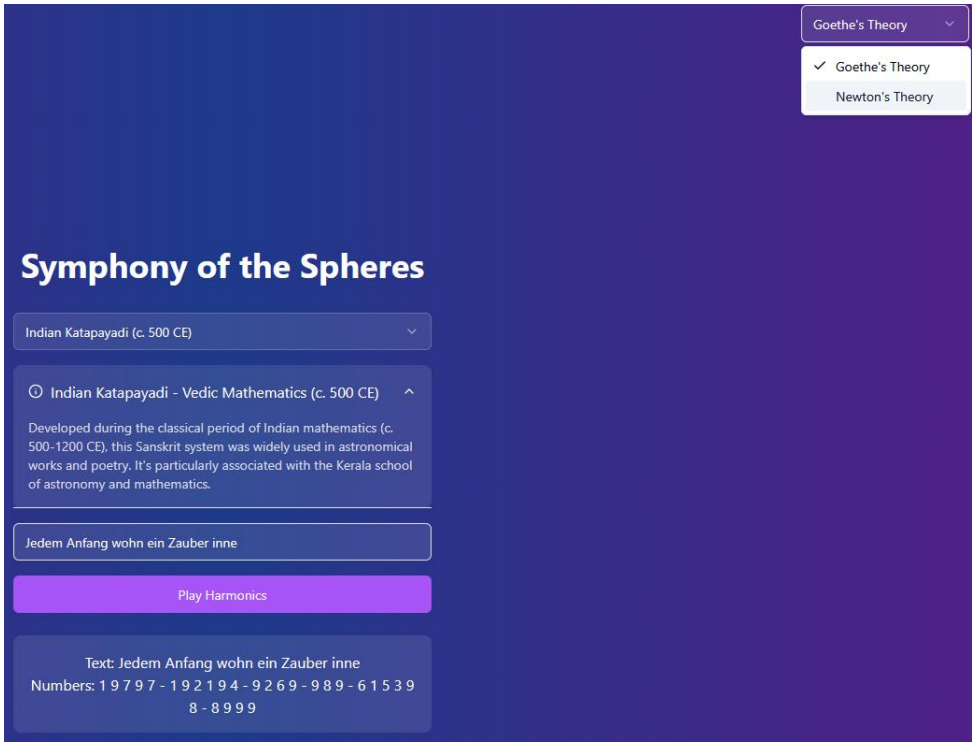
Here is what users experience: They enter a text, perhaps their own name, a poem, or one sentence only in the interface (see below).



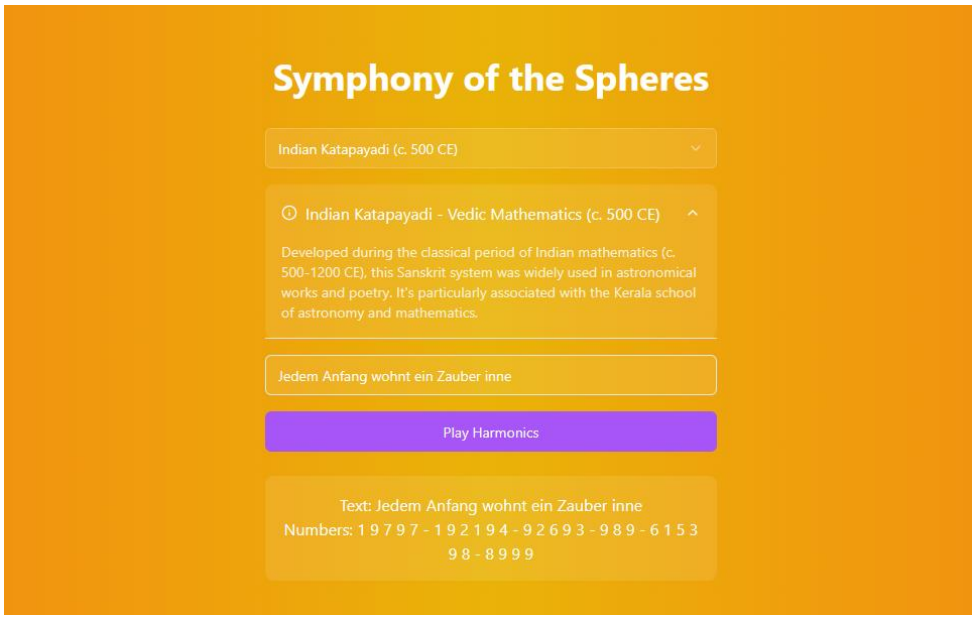
They choose an epoch: Chinese number symbology, Indian numerology, Persian tradition, Hebrew Gematria — or ASCII, the numerical code of the digital age itself. Those systems have been translated into acoustic experience.



In the third step one can choose between color theory by Newton or by Goethe. The first is spectral, objective in the sense of the physics, and prismatic. The latter is phenomenological and subjective. But they are also complementary.



And finally a specific tune unfolds — a numerical signature made audible: strange, even alien, as if forgotten matter has been breathed into life.



Enter the same text again, choose a different era, and a different tune emerges. Each historical era, as an independent cultural knowledge system, can be heard and thus experienced. Although they are dissonant, they offer insight into different sonic landscapes rather than entertain.

The deeper achievement is epistemic, and possibly ontological: the listener constructs meaning through the experienced superposition of letters, numbers, tones, and colors. This meaning-making enacts an epistemic and paradigmatic bridge at historical, cultural, and technical levels:

- Cultural knowledge codes reality differently (historical epistemology), since there is no “natural” connection between the dimensions of meaning. And yet, each system is internally consistent.
- Complementarity is when the same text is floating through different times and gets irrevocably different tunes.
- The contrast of different epochs, colors, and texts enables emergence and learning about difference.
- Paradigmatically, it demonstrates that a classical tool, a binary LLM, and deterministic correspondence tables can together constitute an epistemic intervention that cultivates quantum-relational thinking, if designed to do so.

The connection to quantum mechanics lies in the fact that the tool is a metaphor for quantum encoding. This structure is isomorphic to quantum measurement:

Symphony of the Spheres	**Quantum experiment**
Enter text	Prepare a system
Select epoch, framework	Choose a measurement basis
Select color theory	
Tune	Measurement
Different tunes	Complementary measurements

Transformative potential can be observed here: deterministic media enable non-deterministic competences. Students practice quantum thinking: a mode of thought that embraces quantum relationality, complementarity, and contextual emergence, rather than linear causality and fixed identity. This is a first step in preparation for a quantum worldview without a single formula, enabling an exercise in quantum-relational competence.

Symphony of the Spheres can cultivate three competencies that go beyond traditional teaching methods:

- Contextual emergence: different historical eras produce different tunes (meaning depends on the context in which it is measured)
- Quantum-relational ontology: input and framework bring emergence (observers and the observed constitute each other)
- Epistemic humility / Complementary: often described as tolerance of ambiguity (e.g. OECD Report 2030).

The tool offers an aesthetic rehearsal space for quantum-relational thinking — what Schiller called aesthetic education: not bridging the gap between sensing and thinking, but enabling the transition between them. The practice happens effortlessly, through play and perception, not explanation.[8]

Whether *Symphony of the Spheres* actually shifts ontological defaults or merely aestheticizes them remains an open and empirically urgent question.

4. What does this show?

Symphony of the Spheres reveals that the boundary between binary machines and quantum-relational imagination is not fixed. It can be shaped and molded by our ideas, our design, our suggestions, the questions we ask, and the games we play with machines.

But it reveals something even deeper: that human perception, evaluation, and action has always been quantum-like.[9] Quantum physics now provides us with a scientific vocabulary to describe how reality consists not of things, but of quantum relations. Artists, poets, guardians of inner knowledge, indigenous knowledge systems, and contemplative traditions have always cultivated this knowledge. *Symphony of the Spheres* is a window into this, revealing that cultures across history have thought quantum-relationally long before physics had the language for it.

[8] Schiller, F. (1795). On the Aesthetic Education of Man, Letters 15 and 19. Oxford University Press, 1982 (trans. Wilkinson & Willoughby). https://projekt-gutenberg.org/authors/friedrich-schiller/books/friedrich-schiller-ueber-die-aesthetische-erziehung-des-menschen/

[9] Busemeyer, J.R. & Bruza, P. (2012). Quantum Models of Cognition and Decision. Cambridge University Press.; Khrennikov, A. (2010). Ubiquitous Quantum Structure. Springer.

5. Why do we have to intervene?

Educational policy documents, curriculum standards, and AI-driven learning platforms and emerging quantum technology policies are currently being written by international organizations — the UN, the EU, the OECD — without asking the ontological question: What kind of human being are we inscribing into students, and into machines? If artists do not enter this space, the default will remain: a predominantly substantialist, passive learner, trained to consume a pre-given world rather than co-create an emergent one.

Symphony of the Spheres hopefully shows that another way is possible: creative questions posed to AI remind us of our own quantum-relational potential — and slowly reshape the machines that shape our world.

6. Epilog

Before you finish reading try *Symphony of the Spheres*: *https://symphony-of-the-spheres.lovable.app/*
Enter your name. Choose an epoch. Listen. What has emerged that did not exist before — between you, the tool, and the worlds?