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New Perspectives in Science Education

International Conference
NEW PERSPECTIVES in SCIENCE EDUCATION

The Chronological Ascent to a Spatially Grounded World Model: Merging Geometric Architectures with Large Language Models to Meet Future Education Applied to Industry 6.0

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Content Outline

- **Ground truth** in reality (UNESCO perspective)
- A decade-long timeline (**2016-2026**)
- Geometry: **3D spatial relationships** alongside **natural and programming languages**
- From Leonardo da Vinci's 1514 geometry to modern computational methods
- World model(s) and graph database(s)
- **Points, voxels, and bounding boxes**
- Voxels, collision boxes, and **text-based queries within 3D space**
- **Systematisation of language and spatial concepts**
- Education 6.0 and Industry 6.0 frameworks
- **Challenges** in joint curriculum and syllabus development

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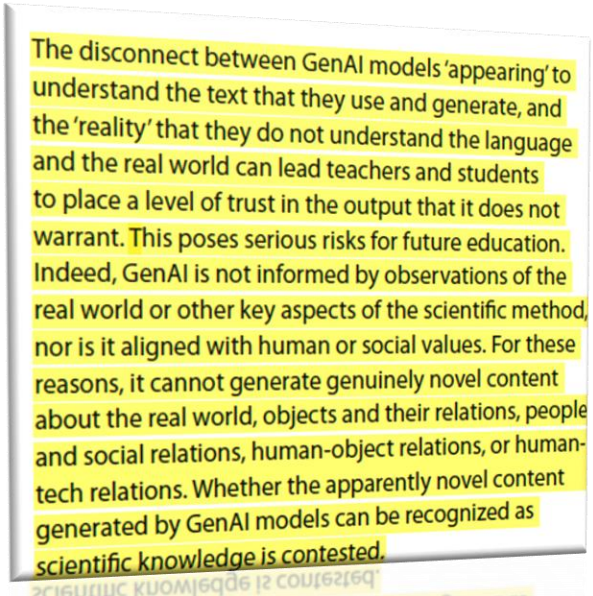
“This highlights an educational paradigm which indirectly points towards a disconnect between general generative AI models ‘appearing’ to understand the ‘reality’ that they do not understand expressed in UNESCO’s ‘Guidance for Generative AI in Education and Research’. This calls for a slight urgency since generative AI are not yet informed by observations of the real world while in science real-world observations constitute scientific ground truth.”


The disconnect between GenAI models 'appearing' to understand the text that they use and generate, and the 'reality' that they do not understand the language and the real world can lead teachers and students to place a level of trust in the output that it does not warrant. This poses serious risks for future education. Indeed, GenAI is not informed by observations of the real world or other key aspects of the scientific method, nor is it aligned with human or social values. For these reasons, it cannot generate genuinely novel content about the real world, objects and their relations, people and social relations, human-object relations, or human-tech relations. Whether the apparently novel content generated by GenAI models can be recognized as scientific knowledge is contested.

Miao., F., and Holmes., W., *“Guidance for Generative AI in Education and Research”,* UNESCO, 2023, https://doi.org/10.54675/EWZM9535 p.16

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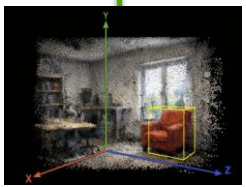
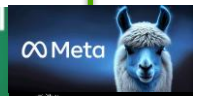
Ten Years (Snapshot) of Building Digitized ‘Reality’

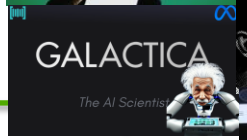
Academia

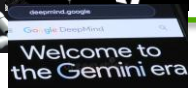
3DLLM

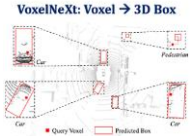
2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026











2016 2017 2018 2019 2021 2024 2025 2026

Industry

Computation
Data Management

ScanQA
ScanRefer

MATH-DT
workshop
in the USA

This highlights an educational paradigm which indirectly points towards a disconnect between general generative AI models ‘appearing’ to understand the ‘reality’ that they do not understand expressed in UNESCO’s ‘Guidance for Generative AI in Education and Research’. This calls for a slight urgency since generative AI are not yet informed by observations of the real world while in science real-world observations constitute scientific ground truth. A key aspect is to reach 3D structure comprehension including shape, orientation and location into practice into our current educations to meet this reality of ours. The worldwide shift from static, textbook-based instruction to spatially grounded World Models and Industry 6.0 innovations is creating an educational environment that nurtures curiosity, deep understanding, and scientific literacy across the globe, while preparing learners for an interconnected, intelligent future.

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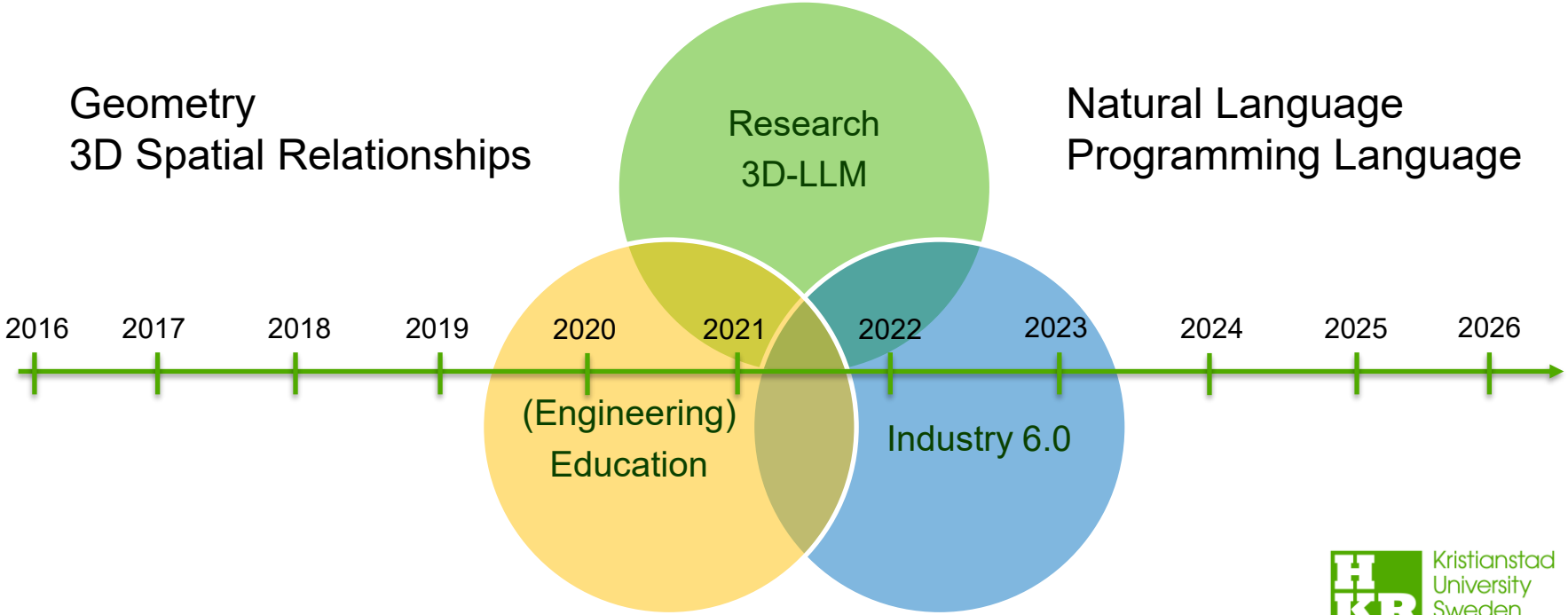
Geometry
3D Spatial Relationships

Natural Language
Programming Language



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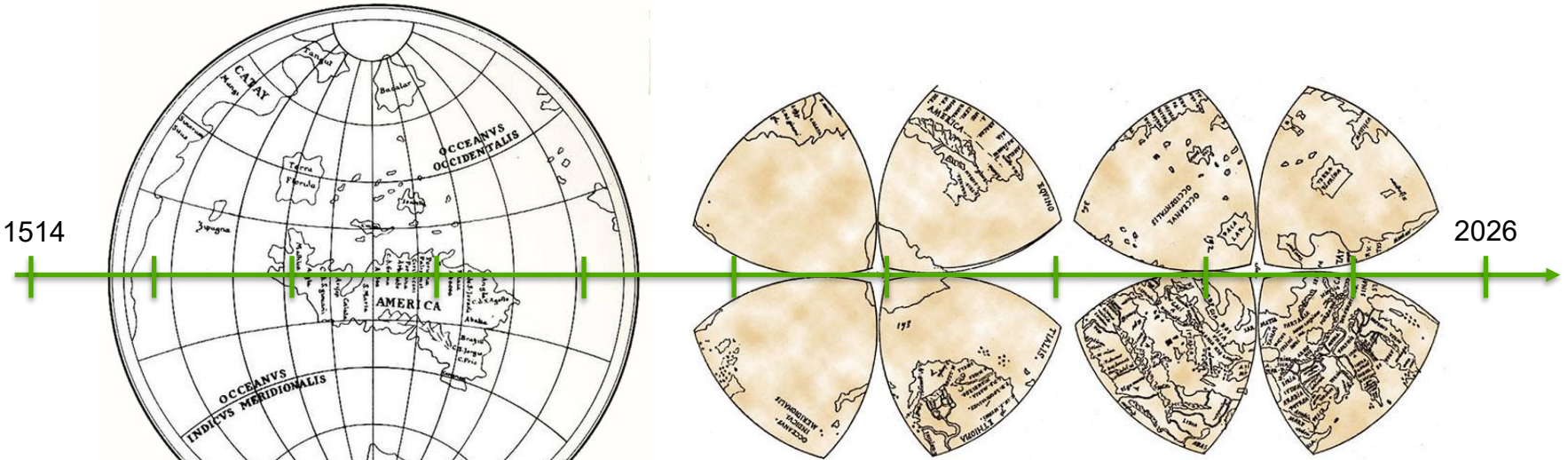
The World Map utilizes a so-called "**octant projection**," where the Earth is divided into eight spherical triangles.



Year 1514

Article: Leonardo da Vinci's World Map by Christopher Tyler | Christopher Tyler

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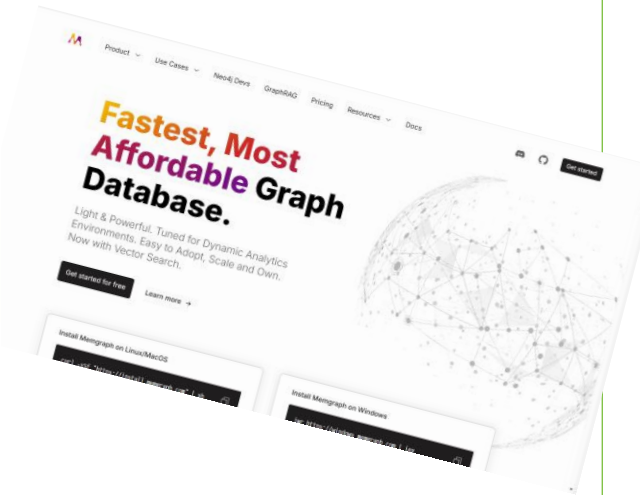
How do we map our world?
For computational benefit and spatial indexation?



Sennersten et al., 2016

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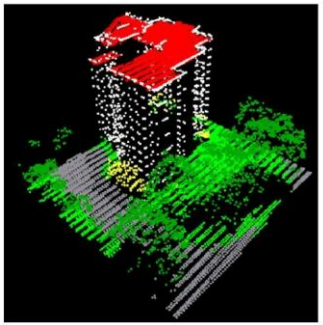
How do we map/represent our world?

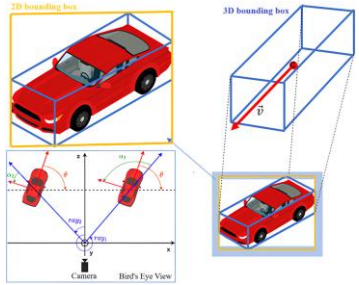
Points (nodes), voxels, …

Dividing 3D space into cubes (voxels) – while optimizing performance and speed.



Point Cloud

Voxel Cloud



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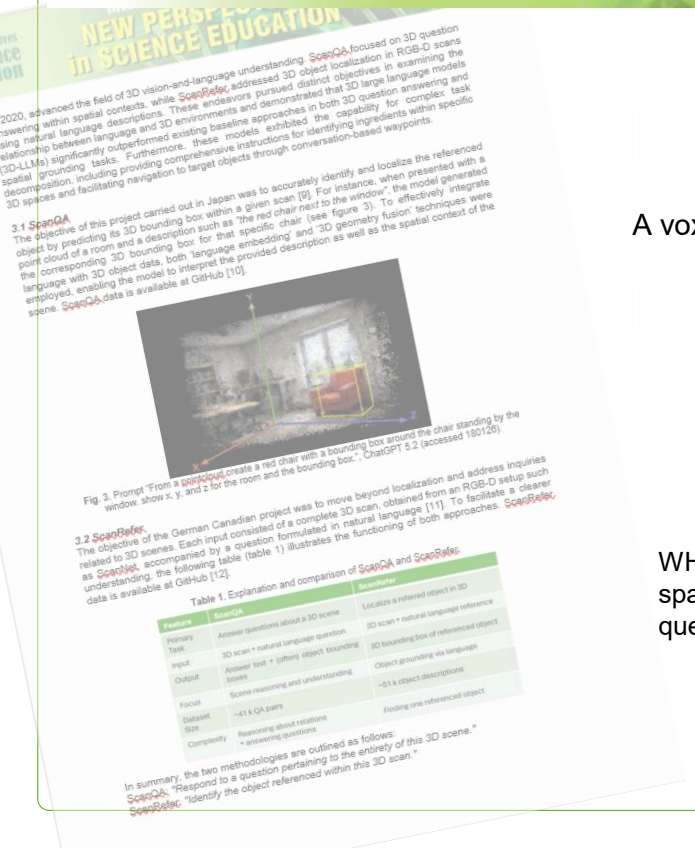
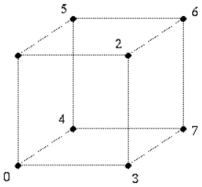
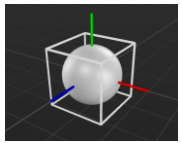


Definition:
A voxel is a volume element, typically a cubic cell.



Collision Box



WHERE is the object spatially when asking questions via language?

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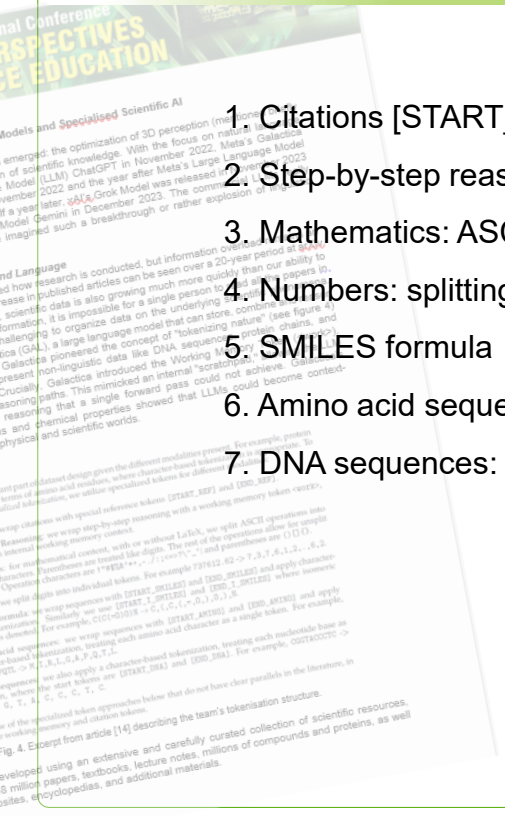

Systemize up language via tokenization:

1. Citations [START_REF] and [END_REF]
2. Step-by-step reasoning: <work> (internal working memory context)
3. Mathematics: ASCII operations into individual characters: !”#¤%&’*+,-./:;<=> ?~^_` and parantheses are () [ ] {}.
4. Numbers: splitting digits into individual tokens, 737612.62 -> 7, 3, 7, 6, 1, 2, ., 6, 2.
5. SMILES formula
6. Amino acid sequences: [START_AMINO] and [END_AMINO], MIRLGAPQTL -> M, I, R, L, G, A, P, Q, T, L.
7. DNA sequences: [START_DNA] and [END_DNA], CGGTACCCTC -> C, G, G, T, A, C, C, C, T, C.

with spatial points/nodes

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Academia 6.0

Education 6.0 is an emerging paradigm that integrates AI, VR/AR, and advanced technology to create a personalized, adaptive, and ethical learning experience. It shifts the focus from mere knowledge acquisition to creation ("Maker Knowledge") and sustainability, aiming to prepare students for the flexible and automated job market (Industry 6.0).

Education 6.0

2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036

Industry 6.0

Industry 6.0 is an emerging, futuristic industrial paradigm focusing on symbiotic, self-evolving systems that integrate advanced AI, robotics, biotechnology, and quantum computing with human intelligence for total sustainability.

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Our Joint International and National Curricula Development Challenges to support Scientific and Engineering Reasoning - A System Approach

2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036

Academia 6.0

Education 6.0

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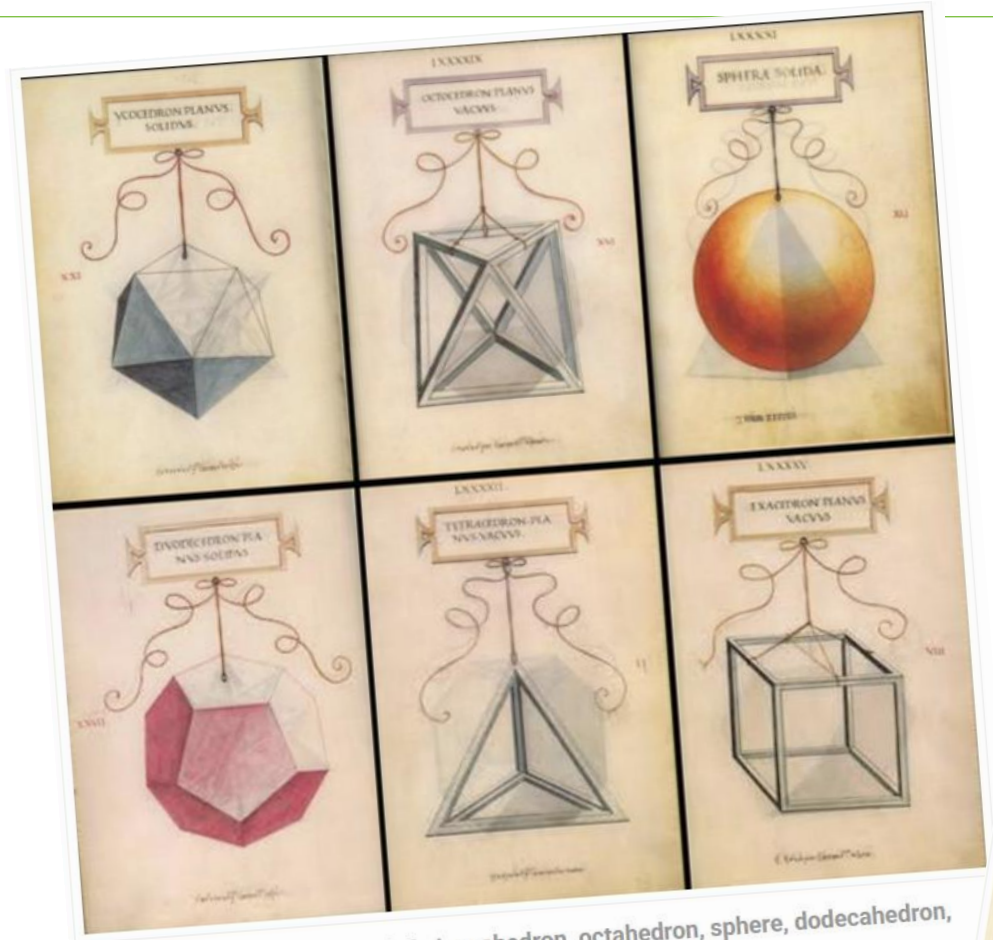

Shapes' names from top left: icosahedron, octahedron, sphere, dodecahedron, tetrahedron, cube