Campus Futures: **Co-creating** with **Social Innovation**

Design Scientists Incubation Program

*Youth explores **climate equity** in high-density urban design through **biomimicry knowledge** and **biodegradable materials**.*

特別鳴謝
Special thanks

Digital Common(s) 數碼共同體

香港青年協會 the hongkong federation of youth groups
賽馬會乙明青年空間 Jockey Club Jat Min Youth S.P.O.T.

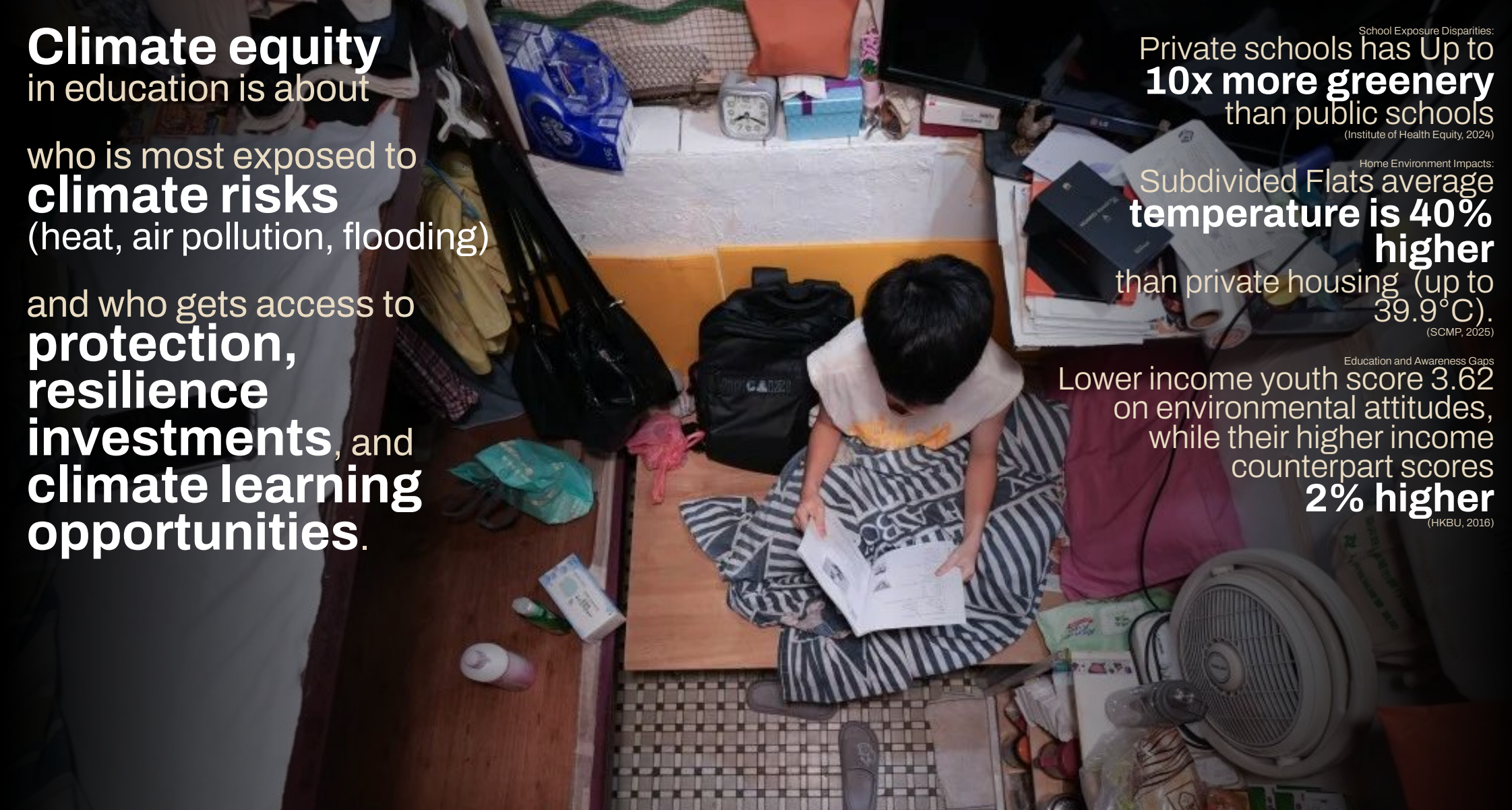
香港青年協會 the hongkong federation of youth groups
隆亨青年空間 Lung Hang Youth S.P.O.T.

香港中文大學 CUHK
學生事務處學生經驗及發展組
Student Experience and Development Section
Office of Student Affairs

建築 中大
School of Architecture
THE CHINESE UNIVERSITY OF HONG KONG

FIGURA

TheMisto.ai



Climate equity
in education is about

who is most exposed to
climate risks
(heat, air pollution, flooding)

and who gets access to
protection, resilience investments, and
climate learning opportunities.

School Exposure Disparities:
Private schools has Up to
10x more greenery
than public schools
(Institute of Health Equity, 2024)

Home Environment Impacts:
Subdivided Flats average
temperature is 40% higher
than private housing (up to 39.9°C).
(SCMP, 2025)

Education and Awareness Gaps
Lower income youth score 3.62 on environmental attitudes, while their higher income counterpart scores
2% higher
(HKBU, 2016)

How can we learn from nature to enhance climate equity?
我們如何向大自然學習以促進氣候公平？

Three gaps

1. **Nature**: subjects are frequently taught in silos, disconnected from the interdisciplinary problems of real world climatic challenges.
2. **Human**: Students lack empowering pathways to develop and test tangible solutions, often leading to apathy, anxiety, and disengagement.
3. **Environment**: School grounds are often seen as static spaces, not as active sites for experimentation.

Three objectives

1. To supports schools in operationalizing applied STEM education with a flagship, cross-curricular project, integrate:
   - ***Biology*** (ecosystems, microorganisms),
   - ***Design & Technology*** (CAD, digital fabrication), and
   - ***Geography*** (urban environment, sustainability).
2. To evaluate effectiveness of **project-based learning (PBL)** pedagogies in nurturing a next generation of leaders through **ESG in STEM** curricular.
3. To identify **volatile spaces in school campus / district** that are increasingly affected by rising temperatures, and might undermine youth's time to play, exercise, and socialise.

Seeds

Anemochory: seeds have thin, wing-like appendages that cause them to spin like a helicopter as they fall, slowing their descent and allowing the wind to carry them farther. A classic example is the maple tree's "helicopter seeds" (samaras).

Samaras

Zoochory: seeds have developed hooks, barbs, or sticky coatings that attach to the fur, feathers, or skin of passing animals. Burdock seeds, for example, inspired the invention of Velcro.

Burdock Seeds

Hydrochory: Plants that grow near water bodies produce buoyant seeds that can float for long distances. The seed is waterproof and contains air pockets that allow it to travel in ocean currents and establish itself on a new shoreline. Such as mangrove trees.

Mangrove Seeds

Autochory:
Explosive ejection: Some plants, like gorse and witch hazel, build up tension in their fruit pods as they dry out. When the tension is released, the pod bursts open and flings the seeds away from the parent plant with force.

Mangrove Seeds

Environmental/ Conditional activation system

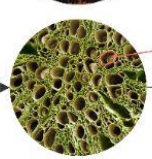
Vascular System

Vascular system in plants is an elaborate network that transports water, minerals, and sugars throughout the plant.

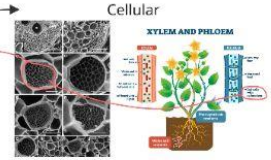
Mycelium

Lsystem/ Shortest Path

Xylem/ Phloem Tissue



Cellular



Inflatable

Inflatable system in nature is a biological mechanism that uses internal pressure from gases or fluids to change an organism's size, shape, or behavior.

Kelp

Floating Elements

Bladderwort

biomimicry

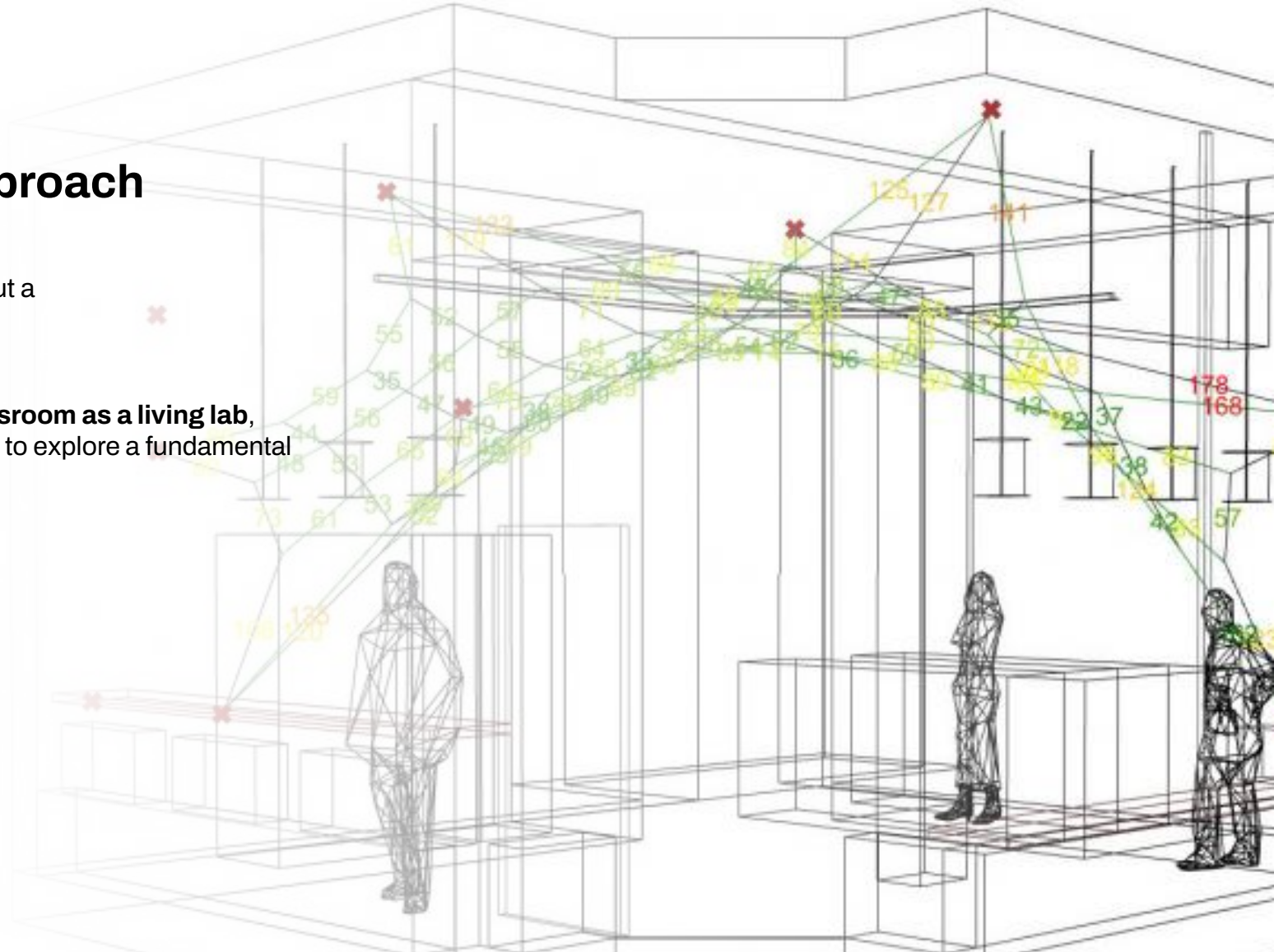
Innovation:

The Urban Living Lab Approach

We hope to prototype a future where
STEM education is not an abstract exercise but a
participatory rehearsal
for **ecological recovery**.

This project seeds a new paradigm for the **classroom as a living lab**, transforming school grounds into fertile ground to explore a fundamental synthesis: between
nature's intelligence and human creativity.

—"The Living Curriculum."

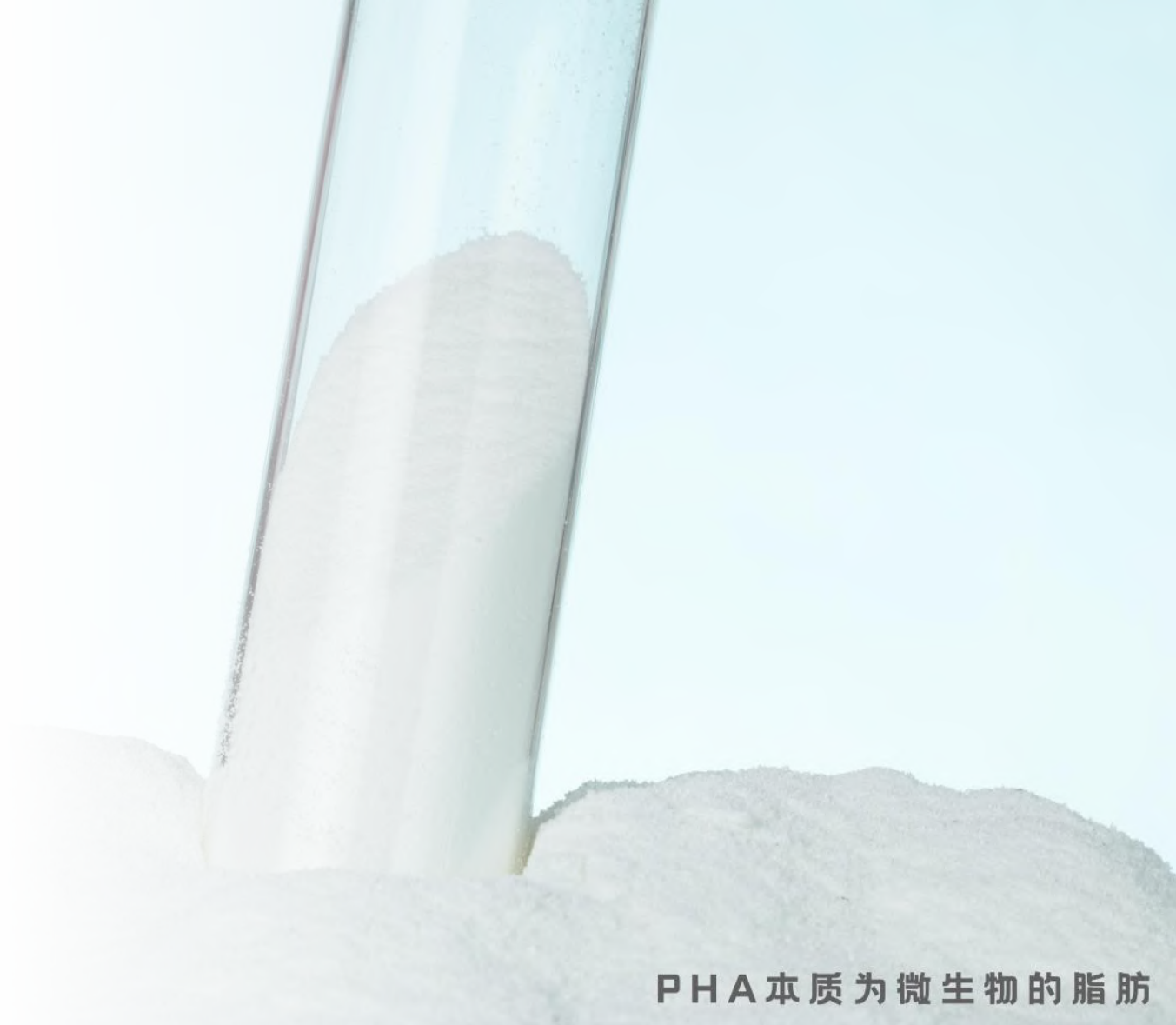


PHA

Made **BY** microbes, **FOR** microbes.

We will design a **structure** optimise the benefit for **soil recovery** with polyhydroxyalkanoates (PHA):

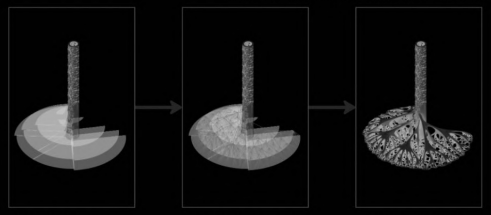
- **Biodegradabile**:
  PHA is truly biodegradable in soil, freshwater, and marine environments.
- **Biocompatibile**:
  It is non-toxic and produced naturally by microbes, making it safe for the soil ecosystem.
- **Tunable Properties:**
  The rate of its degradation can be engineered to match the timeline needed for remediation.



MedPHA

微构工场 PhaBuilder

MANGROVE ROOTING SYSTEM - PHA

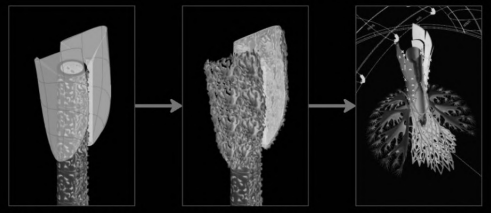


Bioremediation area and modular heights

Branching-like system generation

Branches thicknesses definition and Subd

SOLAR RESPONSIVE CROWN - ABS

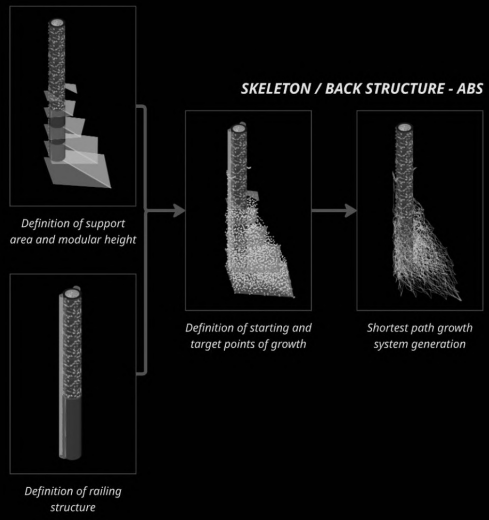


Discretization of surfaces

Reproduction of pattern onto surface patches

Solar optimization for column shading

SKELETON / BACK STRUCTURE - ABS

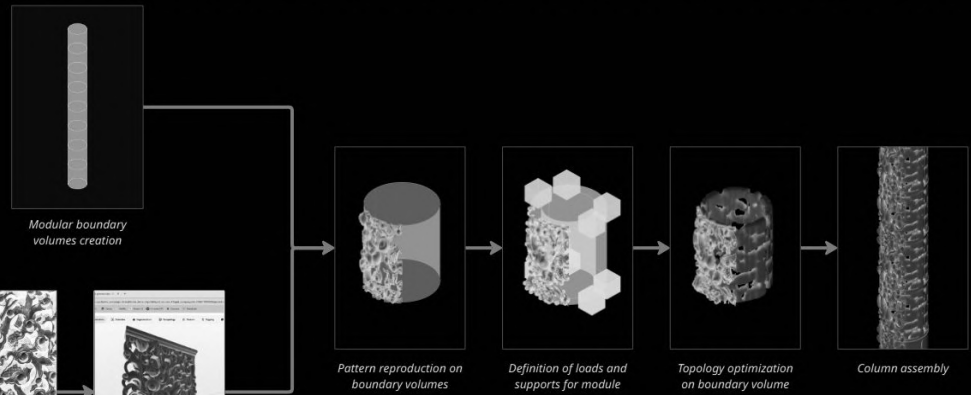


Definition of support area and modular height

Definition of railing structure

Definition of starting and target points of growth

Shortest path growth system generation



Modular boundary volumes creation

Chinese wood carving pattern

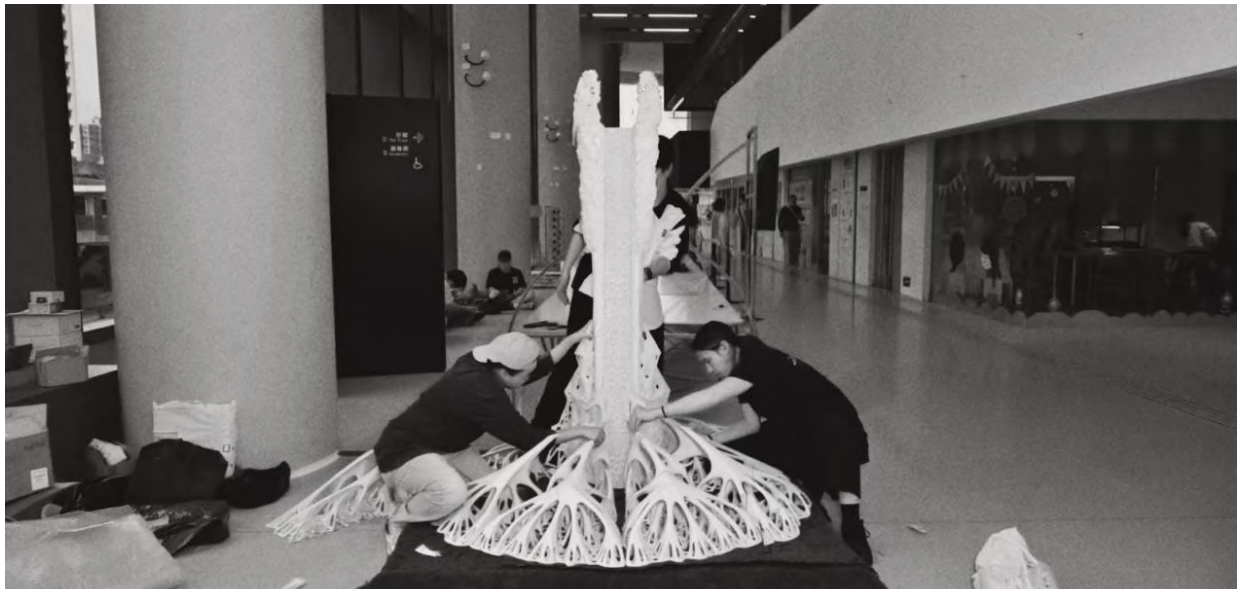
AI-aided 3D model generation

Pattern reproduction on boundary volumes

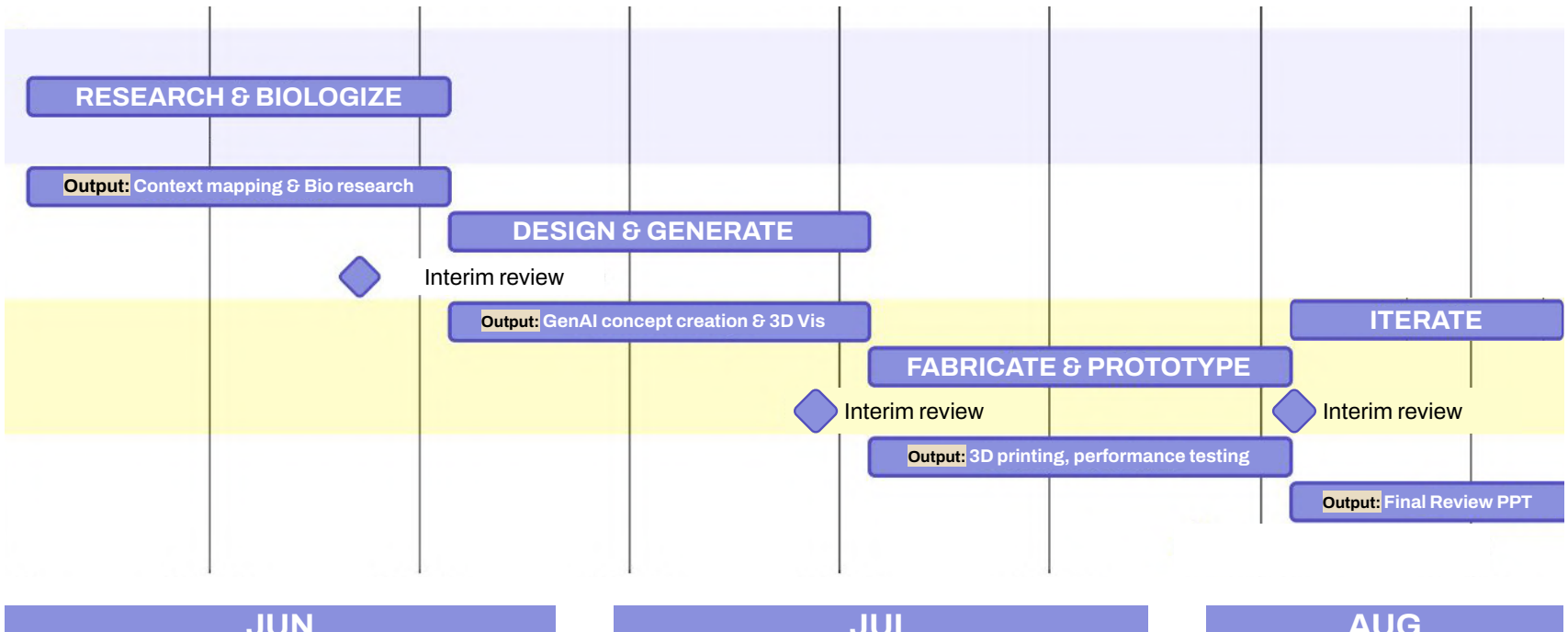
Definition of loads and supports for module

Topology optimization on boundary volume

Column assembly



Timeline


RESEARCH & BIOLOGIZE
Output: Context mapping & Bio research
DESIGN & GENERATE
Interim review
Output: GenAI concept creation & 3D Vis
ITERATE
FABRICATE & PROTOTYPE
Interim review
Interim review
Output: 3D printing, performance testing
Output: Final Review PPT
JUN
JUL
AUG

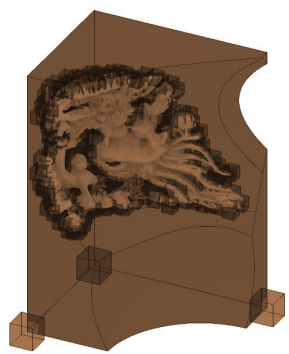
Goals for each stage

GOAL 1.
Understand flooding as a land/water interface design problem

GOAL 2.
Biomimicry = learn from nature

GOAL 3.
Design nature-based solution

GOAL 4.
Co-designing modules with citizens using **biomimicry principles** to embed contextual intelligence



GOAL 5.
Adaptive modularity using the **voxelised approach**, optimise design **using AI and contextual data**

GOAL 6.
3D print modules using **biodegradable material** for sustainable production

GOAL 7.
Participatory construction with all stakeholders

Target Site


Nai Chung Pebbles Beach
泥涌石灘
Tseng Tau Pier
井頭碼頭
Three Fathoms Cove
Nin Wah Rd
SYMPHONY BAY
帝琴灣
NAI CHUNG
泥涌
Sai Sha Rd
SAI O
西澳
GO PARK Aqua
TSENG TAU TSUEN
井頭村
Three Fathoms Cove
企嶺下海
GO PARK Sai Sha
Wu Chau
烏洲
KWUN HANG
官坑
TAI TUNG TSUEN
大洞村
Sai Sha Rd
NGA YIU TAU TSUEN
瓦窰頭村
TAI TUNG WO LIU
大洞禾寮
SAI KENG
Yung Shue O Jetties
榕樹澳漁排碼頭佰級梯

Kwun Hang turned into a vast expanse of water after the rain.

Previous Outcome Example

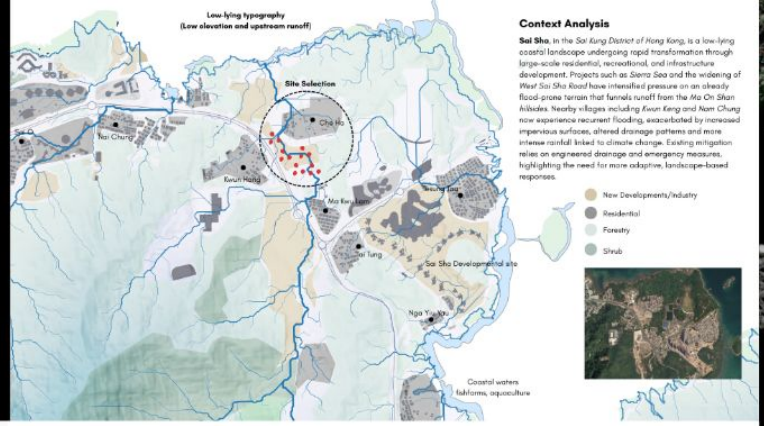
RE_ROOT

Contextual Intelligence: Biomimicry, AI and the Land-Water Interface

Angeline Suriadi, Hollis Hui, Wendy Tse, Fahmeeda Osman
Mentors: Nabi Agzamov, Carlos Rivera, Provides Ng, Jing Chang

Research Question:

How can mycelium-based scaffolding systems and their engineered morphology be used to guide root development, serve as a biodegradable infrastructure that slows, stores, and filters stormwater runoff, and enhance ecological continuity in Sai Sha?



Context Analysis

Sai Sha, in the *Sai Kung District of Hong Kong*, is a low-lying coastal landscape undergoing rapid transformation through large-scale residential, recreational, and infrastructure development. Projects such as *Sierra Sea* and the widening of *West Sai Sha Road* have intensified pressure on an already flood-prone terrain that funnels runoff from the *Ma On Shan hillsides*. Nearby villages including *Kwun Kong* and *Nam Chung* now experience recurrent flooding, exacerbated by increased impervious surfaces, altered drainage patterns and more intense rainfall linked to climate change. Existing mitigation relies on engineered drainage and emergency measures, highlighting the need for more adaptive, landscape-based responses.

- New Developments/Industry
- Residential
- Forestry
- Shrub

RE_ROOT

Contextual Intelligence: Biomimicry, AI and the Land-Water Interface

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Biomimicry Inspiration - Mycelium as a binding agent

"Living systems thinking" approach

How can we as humans leverage non-human organisms to collaborate within a design and fabrication process?

Biocementation for soil stabilisation

Mycelium transforms organic waste into nutrients, binds carbon to the soil, and binds the soil together, making it resilient to heavy rain and floods.

Fungi binds to soil waste to create structure

Using method of biocementation, the mycelium binds to soil grains by the binding agents produced due to microbial reactions.

Visual Inspiration:
Klara Hosnedlova, Echo, White Cube
" **An underground laboratory**"

Increase Biodegradability
Ability of organic materials to be broken down by microorganisms

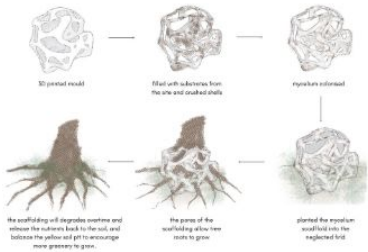
Mycelium and sprouting fungi emerge from their craggy surfaces. The artist creates organic, mycelium-based sculptural forms to introduce **living matter as a durational, unpredictable medium.**

Design Sketches

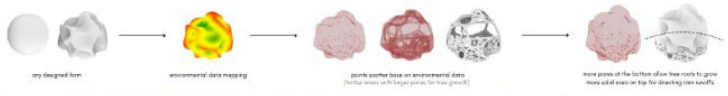
project proposal

How might mycelium-based scaffolding be calibrated—through controlled pore gradients and spatial configuration—to direct tree root growth into defined structural formations, producing adaptive, biodegradable infrastructures that attenuate, retain, and filter stormwater runoff in Sai Sha?

As the scaffold naturally decomposes, it enriches degraded farmland with nutrients, while embedded crushed shells and soil amendments gradually neutralise the acidity of the region's yellow soils, supporting long-term soil regeneration and ecological resilience.



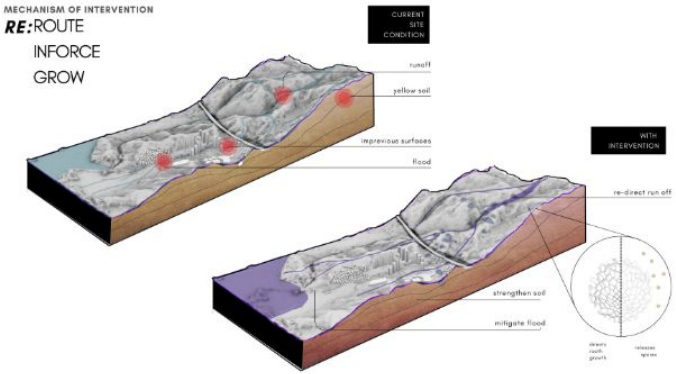
Design Process & Logic



Design Process & Iteration

MECHANISM OF INTERVENTION

RE:ROUTE
INFORCE
GROW



Reflection

This design explores how living systems, such as root networks and mycelium scaffolds, can function as adaptive infrastructure – slowing water, improving soil quality and responding to flood prone landscapes. The workflow translates terrain and hydrological data into emergent, site-specific growth patterns, *guiding rather than dictating form*. Looking forward, this approach reimagines a future of architecture that blurs the line between the built, artificial and natural, treating landscapes as *dynamic living organisms, self-organising actors in ecological resilience.*

Angeline Suriadi
Aspiring architect, focusing on cross-scale mapping, design and research through digital media

Hollis Hui
Artist and Researcher
Focus on digital and interactive media, bio-art, speculative design, and design fiction

Wendy Tse
Interdisciplinary artist, researcher, landscape and architectural designer.

Fahmeeda Osman
Architect & Design Researcher
Focus on design, computation, ecology and emergent technologies

Idea Example

Interlay artificial and natural structure to reinforce steep hills while promoting vegetation growth.

Rooting structure guided by biodegradable material to help relieve soil erosion.

Flood resilient structure that helps ocean creature to rehabitat the area (e.g. oyster that can help clean water).

Takeaways 4 Students

3 Tangible

➔ **Portfolio** for university application.
➔ **Prototype** with 3D print and biodegradable material.
➔ **Exhibition** to showcase outcome.

3 Intangible

➔ **Skills** integration: TECH, STEM, soft skills + design thinking.
➔ **Competition** experience: chance to win a STEM+Design award!
➔ **Network** from our Star Speakers and licensed professionals to diversify career insight.

Previous Mentors & Judges

RESEARCH MENTORS

Dr. Felix Leung

Environmental Scientist

Provides Ng

Lecturer, digital designer, PhD researcher.

Elizaveta DORRER

PhD, Architect, Analyst

Tifa

Architect, educator, PhD researcher.

PROFESSIONAL ARCHITECT & DESIGN MENTORS

Esther Chan

Registered Architect (ARB, HKIA)

Larissa Leung

Registered Architect.

Carson Leung

UK registered architect and researcher

Tracy Wong

Social Communication Practitioner | Design Strategist |

STAR GUEST MENTORS

Prof. Leung Wing Mo

Prof. Leung Wing Mo is the Former Assistant Director of the Hong Kong Observatory; Adjunct professor at the Physics Department of CUHK; and the Chairman of the Guangdong Nuclear Safety Consultative Committee. Prof. Leung is the first professional meteorologist in Hong Kong to host TV weather programmes, including the

Prof. Wong Kam Sing

KS was the Secretary for the Environment of Hong Kong SAR Government in '12-22. During his ten-year tenure as the "environment minister", KS initiated various sustainability policy blueprints, leading HK towards carbon neutrality before 2050. In 2024, KS published the book Hong Kong Stories in the Journey towards Carbon Neutrality. KS has

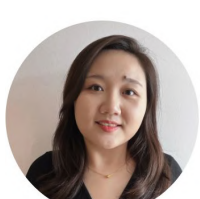
Dr Wendy LEE Woon Ming

Dr Wendy Lee brings extensive management expertise and a proven track record in the development and application of cross-regional innovative technologies, promoting digital education, nurturing talent, and improving technology accessibility. Committed to fostering the integration of technology with industry, Dr Lee is the

GUEST INSTRUCTOR

Nabi Agzamov

PhD Researcher, Architect, GIS Digital Cartographer



Jing Chang

Architect, Computational Designer

INTERNATIONAL TECH SKILLS MENTORS

Yaoyao Meng

Robotics Specialist & Material Research

Carlos Rivera Salaverry

Advanced Digital Designer, Architect.

Weihao Yin

Architect, Engineer, Researcher

Digital Common(s)
數碼共同體

Real World Impact

- *3 years*
- *150+ citizens*
- *15+ prototypes*
- *21 partnerships*

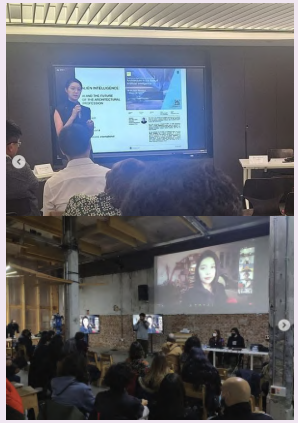
香港青年協會 the hongkong federation of youth groups
賽馬會乙明青年空間 Jockey Club Jat Min Youth S.P.O.T.
I CARE Centre for Whole-person Development
BGCA 香港小童群益會
DESIGNTRUST 信言設計大使 AN INITIATIVE OF THE HONG KONG AMBASSADORS OF DESIGN
基督教香港信義會 沙田多元化全齡服務中心 ELCHK Shatin District Community Centre for the Golden-Aged

Community Pilots

Urban Living Lab with AI
BGCA Partnership
2025

Metaverse Co-creation
HKFYG Partnership
2022-present

Citizen Scientist Program
HK-SZ UABB Partnership
2022 & 2025



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UCL THE BARTLETT
UABB
香港建築師學會 The Hong Kong Institute of Architects

Professional Upskill

Architect AI Upskilling
HKIA Partnership
2025

AI-enhanced learning
CUHK Medicine
2023

Workshop & Certification
Soft Culture Partnership
2023-present

微胞工場 PhaBuilder
CRCA
sens
MedPHA 麦得发

Auto Production

Community Micro-factory
Design Trust Partnership
2024

Urban Mining 2.0
Global Science Summit, Berlin *2025*

Biodegradable Design
MedPHA Partnership
2025-2026

www.provides-ism.com

Data & Validation

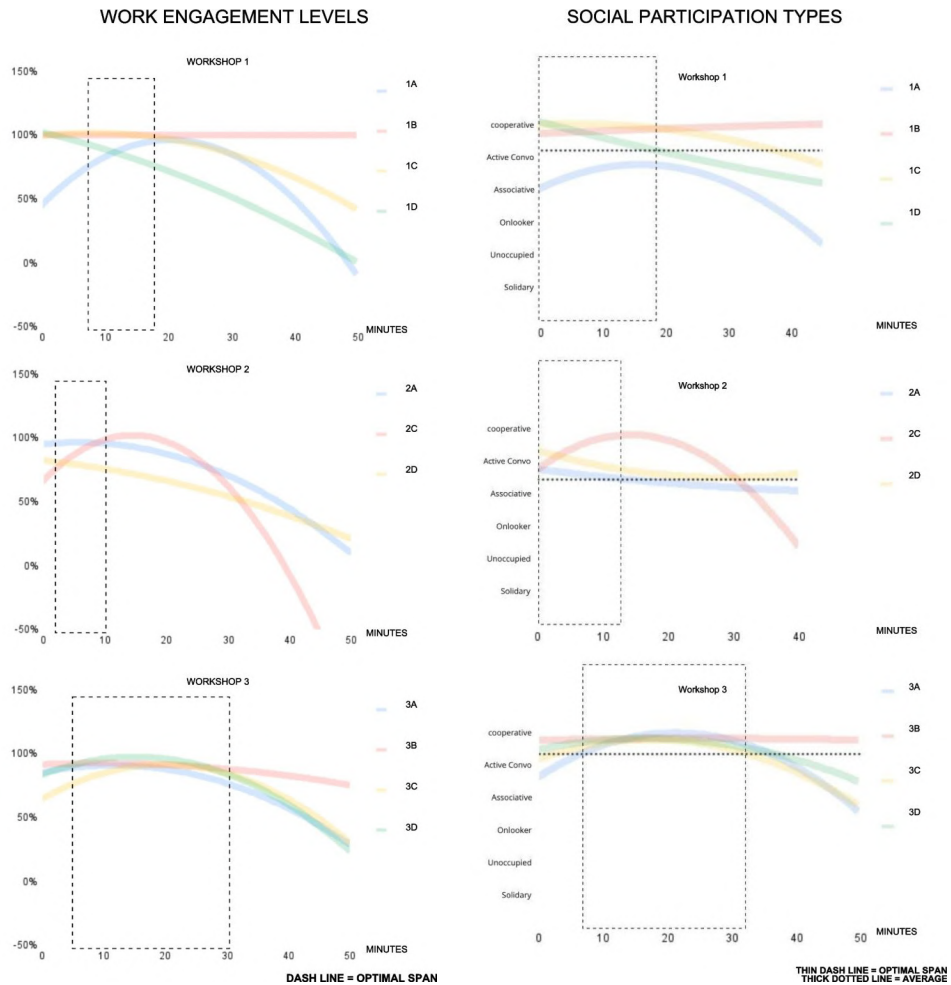
Engagement and motivation increased by 34-40%.

+ Intergenerational cooperation and co-creation in public space design assisted by Virtual Reality (VR) environments. Journal: Architectural Intelligence. Publisher: Springer Nature. Provides Ng, Shutong Zhu, Yuechun Li, and Jeroen van Ameijde. (2024). https://doi.org/10.1007/s44223-024-00080-1

+ Digitally-Gamified Co-Creation: Enhancing Community Engagement in Urban Design through a Participant-centric Framework, Journal: Design Science. Publisher: Cambridge University Press. Provides Ng, Shutong Zhu, Yuechun Li, and Jeroen van Ameijde. (2024). https://doi.org/10.1017/dsj.2024.17

+ Challenges and Opportunities of Using Metaverse Tools for Participatory Architectural Design Processes. Journal: Virtual Worlds (Vol. 3, No. 3, pp. 283-302). Publisher: MDPI. Ng, P., Eloy, S., Raposo, M., González, A. F., da Silva, N. P., Figueiredo, M., & Zuberi, H. (2024, July). https://doi.org/10.3390/virtualworlds3030015

+ Digital common(s): the role of digital gamification in participatory design for the planning of high-density housing estates. Journal: Frontiers in Virtual Reality. Publisher: Frontiersin. Provides Ng, Yuechun Li, Shutong Zhu, Bingge Xu and Jeroen van Ameijde. (2023). https://doi.org/10.3389/frvir.2022.1062336



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Intergenerational cooperation and co-creation in public space design assisted by Virtual Reality (VR) environments

Research article | Open access | Published: 03 January 2025

Volume 4, article number 1, (2025) Cite this article

Provides Ng, Shutong Zhu, ... Jeroen van Ameijde Show authors

Abstract

The world's ageing population presents both challenges and new opportunities for urban design, particularly in high-density cities like Hong Kong. This study investigates intergenerational cooperation in the co-design of urban public spaces, assisted by Virtual Reality (VR) environments. Through a series of workshops inviting youth, university students, middle-aged adults, and older residents to work in small teams, we documented their interactive behaviours and observed how the involvement of different age groups may influence the cooperative process and design outcomes, especially when VR tools were involved. Our findings shed light on several key aspects. First, how work engagement levels differ based on highly-, moderately-, and non- intergenerational groups. Second, observable patterns of common task-role distribution between age groups within a self-organised collaborative process. Thirdly, the various types of social participation, from cooperative, associative to solitary, emerged as a consequence of such interactions. Finally, from the co-created public space designs, any transformational and transactional values that arise were discussed. The study contributes to ways in facilitating more age-friendly approaches in urban design, especially in face of digital transition, and highlights the importance of intergenerational cooperation in design processes so as to create more inclusive environments.

參加者感言

經過呢次活動之後，本人覺得雖然我們做的合作能力不是最好的。而且中間亦科技或是溝通上發生了很多小問題，但是我都無法忘記我們合作時和獲益良多的經歷。

——— Tokiwa

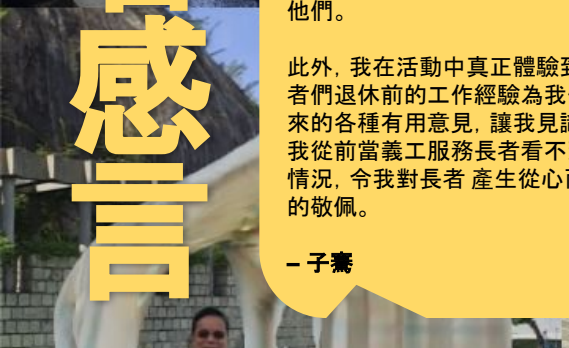
地球本一家
膚色無分差
人人都要愛
关心暖萬家

– Bingbing

我在活動中了解到自己對設計建築的興趣。但對我而言，設計時了解用家意見時的 說話技巧是最有用。我們很多時候關心別人會著重於他們當中的情況，而忽略了他們的感受，因此無意中傷害了他們。

此外，我在活動中真正體驗到長者們退休前的工作經驗為我們帶來的各種有用意見，讓我見識到我從前當義工服務長者看不到的情況，令我對長者 產生從心而發的敬佩。

– 子豪

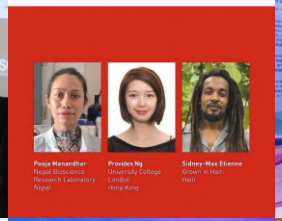


通過是次活動，讓我感受到同齡組別，及不同齡組別的特性。透過超過數十小時的溝通，更得到意想不到的結果。這是我在 2024 年的收穫！

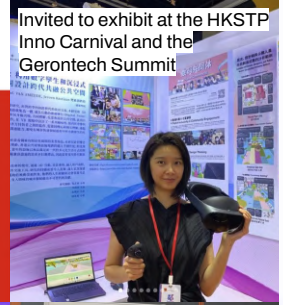
– Mingming

KNOWLEDGE

Finalist at the Global Science Summit (Falling Walls Foundation)



Invited to exhibit at the HKSTP Inno Carnival and the Gerontech Summit



COMMUNITY

Champion of the SZ-HK Chinese University Joint Research Forum

Second runner-up at 9th Hong Kong Uni Innovation and Entrepreneurship Competition

INTERNATIONAL

Hong Kong Teaching and Learning Innovation Expo Silver Award for Education Technology Innovation

INDUSTRY

Invited exhibitor of the Hong Kong Institute of Architects' roving exhibition

Received news coverage from Hong Kong East Week Magazine

"Ultimately, we are not just serving a user group; we are building our own future. We will be the leaders of tomorrow. This is not a passion we have; it's our responsibility. We hope you can join us to create this future where we would happily live greener, together."

Special Thanks

We are very grateful to the support provided by all of our funders, sponsors, and partners. Most importantly, we thank all our participants, without whom, this project would not have been possible.

School of Architecture, The Chinese University of Hong Kong

I.CARE Centre for Whole-person Development

SENS SEN Service

香港中文大學圖書館 CUHK Library

香港中文大學 研究院 CUHK Graduate School

CRCA

集籽穗城 Seeds of Resilience

香港青年協會 The Hongkong Federation of Youth Groups

賽馬會乙明青年空間 Jockey Club Jat Min Youth S.P.O.T.

基督教香港信義會 沙田多元化金齡服務中心 ELCHK, Shatin District Community Centre for the Golden-Aged

BGCA 香港小童群益會

DESIGNTRUST 信言設計大使 An initiative of the Hong Kong Ambassadors of Design

UCL The Bartlett

香港建築師學會 The Hong Kong Institute of Architects

微构工场 PhaBuilder

MedPHA 麦得发

Connect & Collab!