

THE UNIVERSITY OF HONG KONG 香港大學 faculty of architecture 建築學院



#### **Invigorating AEC education using Minecraft:** A case of LiDAR surveying and virtual learning

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#### **1. Background - subject**

- ♦ City evolves, e.g.,
  - New underground dev.
- Slowly aging buildings Surveying is always demanded
- Surveying tools evolve, too ■ Theodolite (1787) Laser scanner (1993) ■ Color laser (2018)
- Complex data and operations To teach





(Sources: Authors 2019, 2022)





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## 1. Background - challenges

Online/mixed teaching mode is necessary Social unrest in Hong Kong (2019) Covid-19 impacts (2020-22) ♦ Video conferencing software is good, yet we ... • Experiential learning (e.g., surveying) Interactive, creative 3D contents • Hard on a shared video conf. screen Motivating and collaborating students as groups Generation Z students

- born in 1997~2015
- Internet native
- Not favor traditional lecturing







#### 2 **Opportunity**

- iLab
- Minecraft <u>Education Edition</u> (MCEE)
  - Programmable education sandbox platform for 3D worlds
    - A world's top popular game (180M monthly active players)
    - Multi-user interaction (LAN/Internet server)
    - Familiar by Gen-Z
    - With <u>Python/Scratch</u> coding interfaces
  - <u>Free</u> for all HKU staff/student accounts
  - <u>Available</u> for laptop (Mac, Win), iPad, phones
- ♦ Example cases
  - UC Berkeley's 2020 virtual graduation ceremony (a)
  - UPenn's virtual student event in 2020 (b)





(source: ABC News 2020; BI 2020)



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### **3 Research design**

- Pedagogical theory
  - Experiential learning
  - Dewey and Kolb's (1984) cycle model
- ♦ Focus in this paper
  - Interactive learning and co-design with groupmates
- In a shared virtual world, not a shared screen
   Objectives
  - To try MCEE's delivering of 3D T&L contents
    - $\circ~$  E.g., gamified urban model to Gen Z students
  - To promote group co-design and co-creation with a shared virtual environment in MCEE



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#### 4 Case 1: Mobile LiDAR surveying

- Case area
  - S.Y.S. Steps
  - Next to our Dept.
- ♦ 3D surveying
  - In group
  - With operation tips and guides
- Device: a mobile laser scanner
  - Paracosm PX-80
  - 3 sets





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### 4 Case 1: As-built modeling with MC

blocks.fill(mat.

def sys steps():

# repeat 3 times

h = i \* 2h += 1d = i \* 6

d += 3

♦ 3D measurements ■ WDH, slope

♦ Modeling

Python code for regular parts

• Automatic (1-click)

Student's detailing/design





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### 4 Case 1: Feedback from RECO7613

- ✤ Top entries in students' SFTL
  - "Requires my <u>active</u> <u>participation</u>"
  - "Stimulated me to be creative"
- Every student enjoyed interactive T&L with friends
  - A creative scene: Setting <u>fire</u> on fire gathering points
  - Student B: "There are even more benefits compared with traditional education, such as <u>digital liberty, social skills and</u> <u>online security</u>."



(Sources: RECO7613 21/22)



#### 5 Case 2: Underground facility



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♦ MTR West Island Line • under Main Building, HKU Many do not realize ♦ MC model Under campus • With transparent sections ■ (Note: distance to ground reduced by

~40m)



#### **5 Virtual HKU campus above the metro line**



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#### Coverage



Details
Exteriors
MTR West Island Line
Limits
20 players in one world



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#### **6** Summary

Summary

■ Minecraft (MCEE) is programmable media for smart city T&L

- $_{\odot}~$  Helping educators on 3D interactive T&L contents
  - 1 As-built 3D modeling
  - 2 Underground facilities
- Enriching students' group learning experiences
- Minecraft model is friendly to co-design and co-create
  - $_{\circ}~$  Promoting learners-interaction and teamwork

♦ Future work

- Extension to other complex 3D surveying T&L
  - $_{\odot}~$  E.g., concrete subsurface scanning
- Extension MCEE's measurement APIs to sustainability T&L
  - $_{\odot}\,$  Materials, quantity, and CO2 estimation





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    - Multi-user Internet Narrative Environment of HKU (MineHKU) for smart city courses and virtual campus events
- $\boldsymbol{\diamondsuit}$  Minecraft models and Python codes
  - Free for HKUers
  - Available for research purpose on request



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# Unleashing Gen-Z students' potential with new T&L!

Q&A

