Building software interfaces to promote students' learning and agency

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SCHOOL *of*
HUMANITIES
THE UNIVERSITY OF
HONG KONG

Teaching context

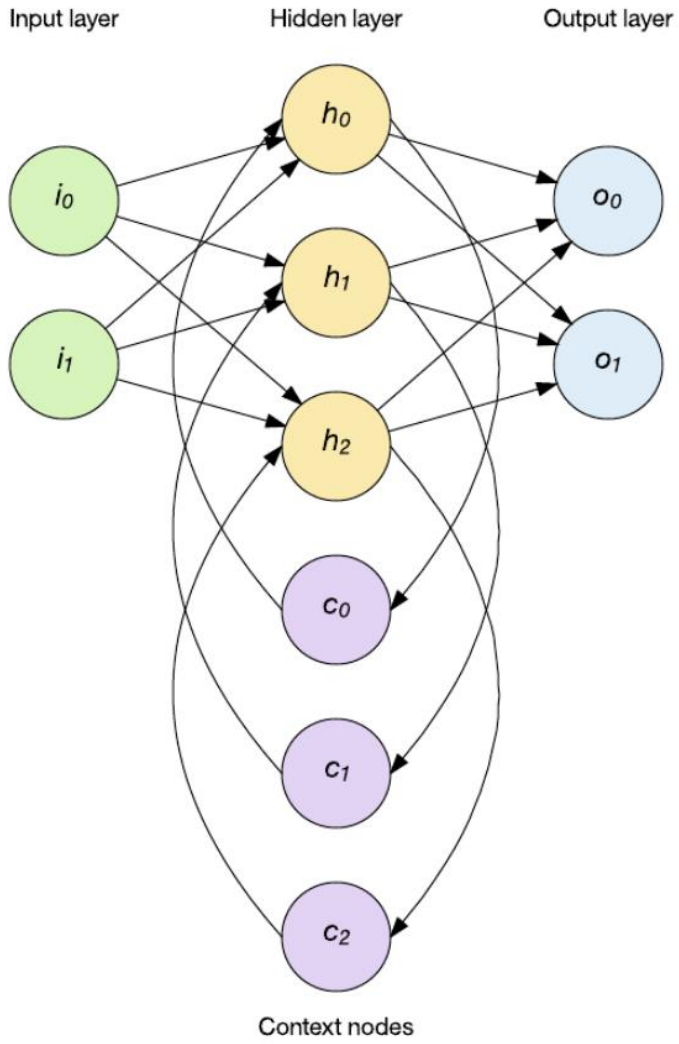
Teaching quantitative / digital / computational approaches to students outside of the Faculty of Science

- Faculty of Arts, Common Core program
  - *"Introduction to Data Science"*
  - *"Introduction to Natural Language Processing"*
  - *"Computational Approaches to Language"*
  - *"Digital Humanitarianism (Can you save the world with your computer?)"*

Teaching context

Teaching a range of techniques…

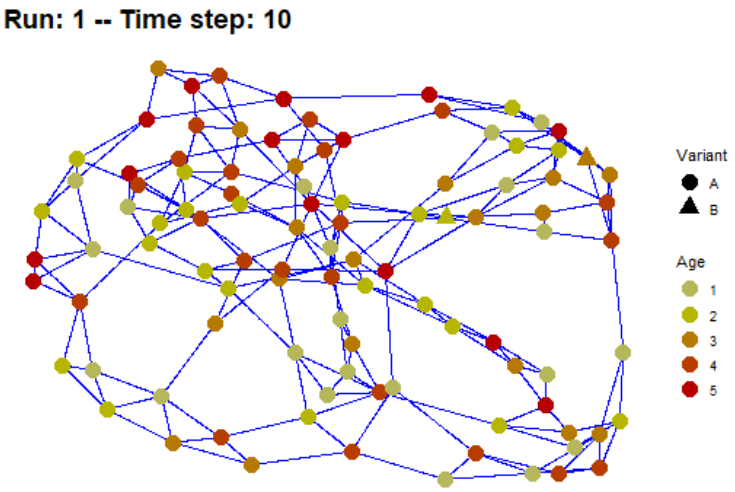
- Statistical tests and models
- Machine learning
- Text-mining techniques
- Computational modelling
  - e.g., agent-based modelling



Teaching context

… but also an epistemology

- How does one generate knowledge with quantitative / computational approaches?
  - *How to study the diffusion of cultural innovations with artificial populations?*
  - *What are the key differences between an artificial population, and a real one?*
  - *What is the role played by 'randomness'?*
  - *How do various values of the parameters of a model impact the output of a computer simulation?*



The teaching challenge

Students are often concerned they can't come to grips with such topics…

- Although the vast majority is totally capable to do so

… but understanding the role machines and digital tools play in research, art, policy-making etc. is ever more important

What are possible approaches?

Overview

1. **Teaching approach**
2. **Focusing on what matters**
3. **Enriching activities**
4. **Experimenting and experiencing**
5. **T&L, research, and art**

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Agency as a teaching philosophy

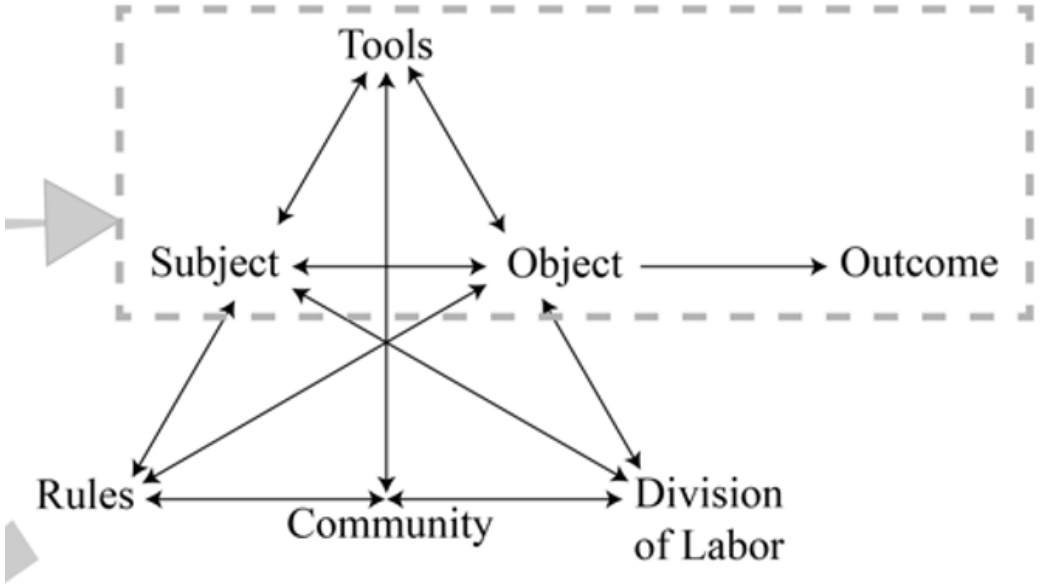
To tool up someone's power to act

(P. Rabardel)

Pierre Rabardel
(1945-2021)

'To tool up': generic / concrete meaning

How to approach activity and agency?



A point of view from ergonomy

Yrjö Engeström's system of activity (1987)

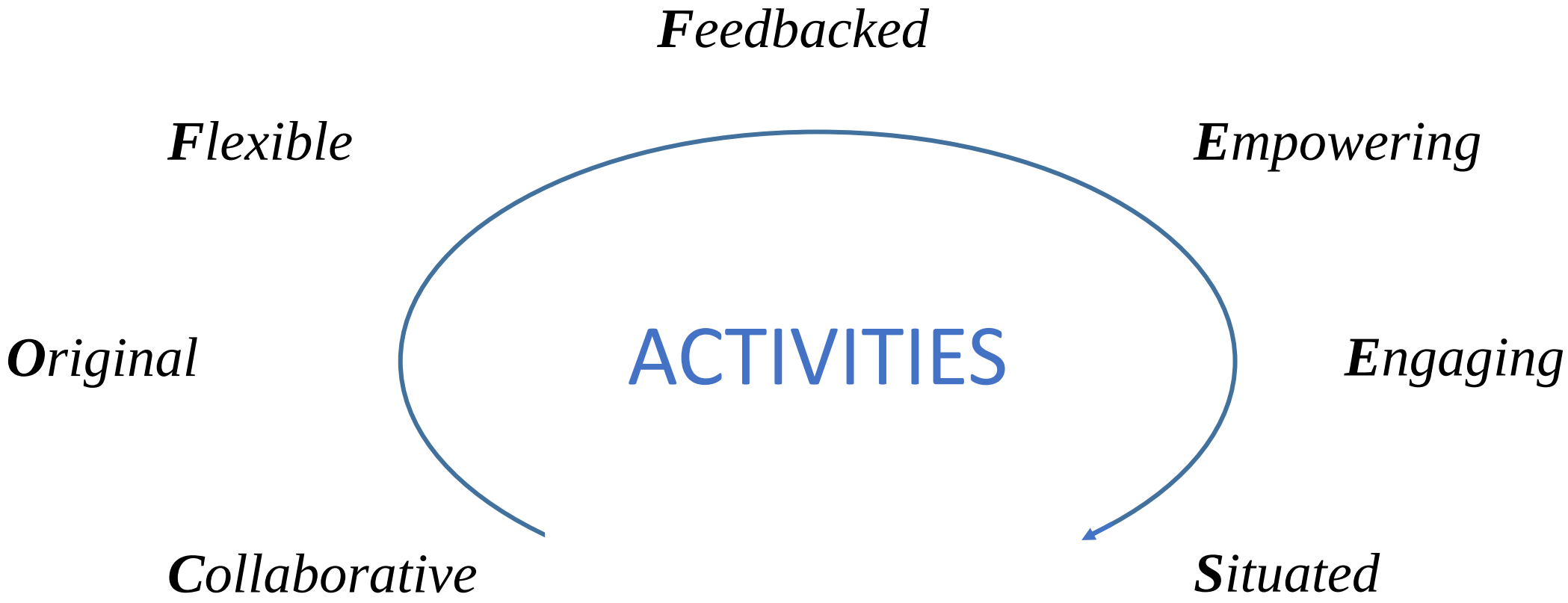
Activity and agency in the classroom?

Design learning experiences which

- encompass the ‘wholeness’ of human activity
- mirror the challenges outside the classroom

Make time for T&L activities

- Flipped classroom by default



‘COFFEES’ design principle

Applying COFFEES principles (step by step)

ILO: in a course on language evolution, reflect on our linguistic abilities and related ‘humanness’

Step #1: Individual reflection

Lecture on apes trained to acquire language

Each student prepares a list of arguments in favor or against the idea that trained apes should be seen as human beings

Original (using trained apes as a contrastive point)

Step #2: Reflection and feedback

The teacher summarizes students’ arguments and comments on them

Feedbacked

Applying COFFEES principles (step by step)

ILO: in a course on language evolution, reflect on our linguistic abilities and related 'humanness'

Step #3: Group debate

Two groups prepare their arguments in favor of or against Nim Chimpsky (a trained ape)'s humanness

They then debate with each other

The teacher throws in some arguments when deemed relevant

Collaborative, Engaging

Step #4: Situated group debate

A background story in which a trained ape sold to a pharmaceutical company kills their abusive caretake

→The chimp is trialed, with one group of prosecutors and one group of defense attorneys

Arguments to accuse or defend the chimp may actually promote or minimize their abilities

Situated

It is not always possible, nor likely desirable, to implement all the principles

A journey of gradual refinement - No need to think of everything from the start

How can I ‘tool up’ my students’ agency when it comes to quantitative/computational approaches?

By taking Rabardel’s motto literally, and building software tools which favor agency and learning

- For T&L activities and graded assignments

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Experimenting with text-mining tools (3y ago)

```
  labs(x="Most frequent lemmas", y="Frequency") +
  geom_text(aes(label=round(freq,2)), size=3, hjust=-0.5) + theme_grey(base_size = 12)

# Let's now create a word cloud to visualize things a bit differently
wordcloud2(data = head(nb.lemmas, n=nb.words.wordcloud), size = 0.8) # changing size will draw words bigger/smaller (one has to adjust to the window size)



# * Collocations and network of collocations ####

# Collocations are pairs (or triplets, quadruplets etc.) of terms which appear together more than what chance alone would predict
# There are different ways to assess this and choose collocations. Here, we rely on a statistical approach named Log-frequence biased MD (LFMD)

# <<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<
# Selecting a subset of text to perform the analysis

# At the first level of classification, which groups do you want to keep?
categories.1 <- "all" # you can choose one element, two, three
# At the second level of classification, which groups do you want to keep?
categories.2 <- "all"

# Choosing upos categories and stop words
upos.categories <- c("NOUN", "ADJ", "VERB") # Here you can choose the syntactic categories you want to focus on
# Here you can choose words you don't want to consider

nb.gram <- 3 # This defines the largest possible collocations
nb.collocations.displayed <- 30 # How many collocations you want to see
nb.collocations.displayed.network <- 200 # How many cooccurrences you want to see in the network

# >>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

selected.content <- select.subset(content, categories.1, categories.2, upos.categories, my.stop.words) # Selecting a subset of data

selected.content <- selected.content %>%  filter(lemma != "Å")

# We first call the function keywords_collocation which extract collocations
my.collocations <- keywords_collocation(selected.content, term = "lemma", group = "class_1", ngram_max = nb.gram)
my.collocations <- my.collocations[order(-my.collocations$lfmd),] # We sort the collocations in decreasing order according to LFMD
my.collocations$keyword <- factor(my.collocations$keyword, levels = rev(my.collocations$keyword)) # We create a factor

# Simple text display the strongest collocations:
head(my.collocations, n=nb.collocations.displayed) # The combinations with the highest "Log-frequence biased MD"

# A nicer barplot to display the most meaningful collocations
ggplot(my.collocations[1:nb.collocations.displayed,], aes(x=keyword, y=lfmd)) +
  geom_bar(stat="identity", fill='white', color="grey50") +
  coord_flip(ylim = c(min(my.collocations[1:nb.collocations.displayed,"lfmd"]), 0)) +
  labs(x=paste0(nb.collocations.displayed, " most relevant combinations"), y="Log-Frequency biased MD (LFMD)") +
  geom_text(aes(label=round(lfmd,2)), size=3, hjust=-0.5) + theme_grey(base_size = 12)
```

Sharing a well-explained code that students can modify to generate various outputs…

Observations after the first run (1/2)

Students managed quite well and wrote good assignments

- With different text corpora on offer, students could choose what they preferred, and grading was less repetitive
- Some students asked to work on other texts
  - e.g. *The Communist Manifesto* by K. Marx

Observations after the first run (2/2)

However…

1. Installing required software turned out to be more time-consuming than thought of at first
2. It was quite easy to modify the code inadvertently, and students were often not able to trouble-shoot an unexpected error. Need to ask and wait for help
3. Some students (rightly) complained the whole thing was too complex and confusing

4. The programming part was not that relevant. **Understanding text-mining takes place at a higher level**

TAME: *Text Analytics Made Easy*

To improve on the previous approach, develop an online interface offering the same 'affordances'

- Easy to access and use (no installation needed)
- Focus on the outputs of various text-mining tools
  - as they could be found in other software
- Focus on complementary perspectives on the same set of documents

TAME: *Text Analytics Made Easy*

TDG grant to recruit two CS students to get help

- Develop a set of interfaces, especially in relation to text mining/analytics
- Did not require amazing programming skills, but a more global understanding of how these interfaces could enhance T&L

Different languages for the interface

- English, French, Mandarin

Freely available (online)

Observations after the next run(s)

1. **Much easier to investigate a set of documents**
2. **Interesting, varied and nuanced assignments**
3. **No more complaints**
4. **Positive evaluations, students reporting that the ILOs were achieved**

Focus on what matters

At the right level

New opportunities offered by digital tools

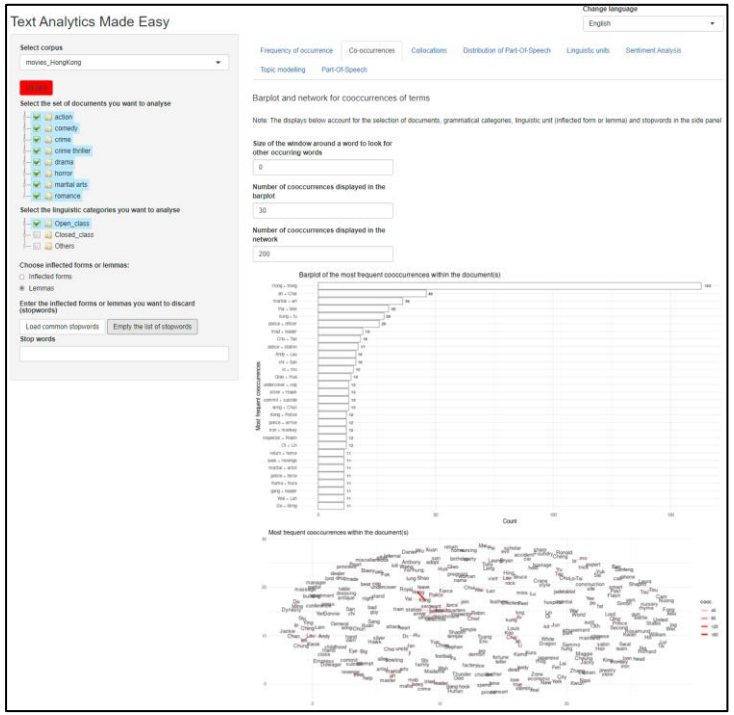
- E.g., Revisiting old questions, addressing large volumes of data

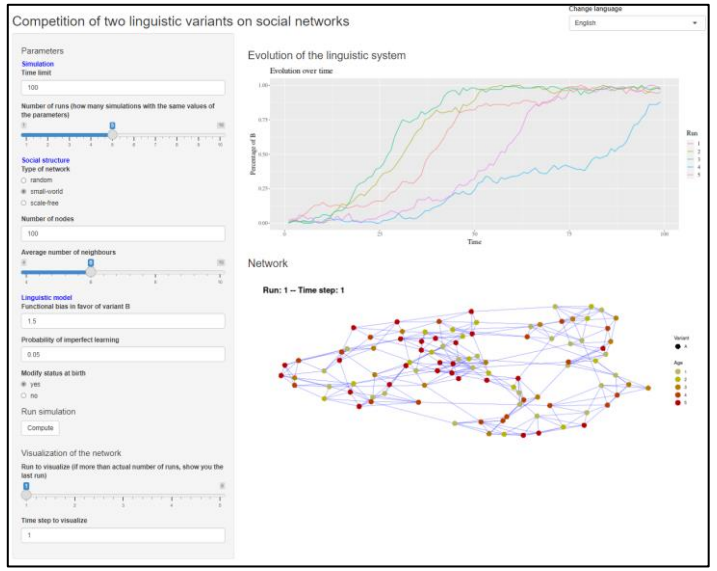
Limits

- E.g. reductionism, opacity

Possible pitfalls

- E.g., algorithmic bias

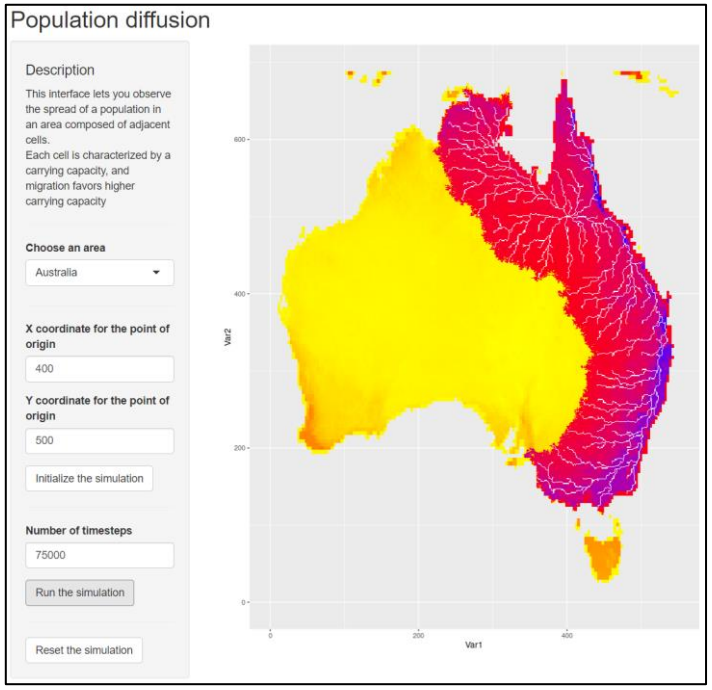


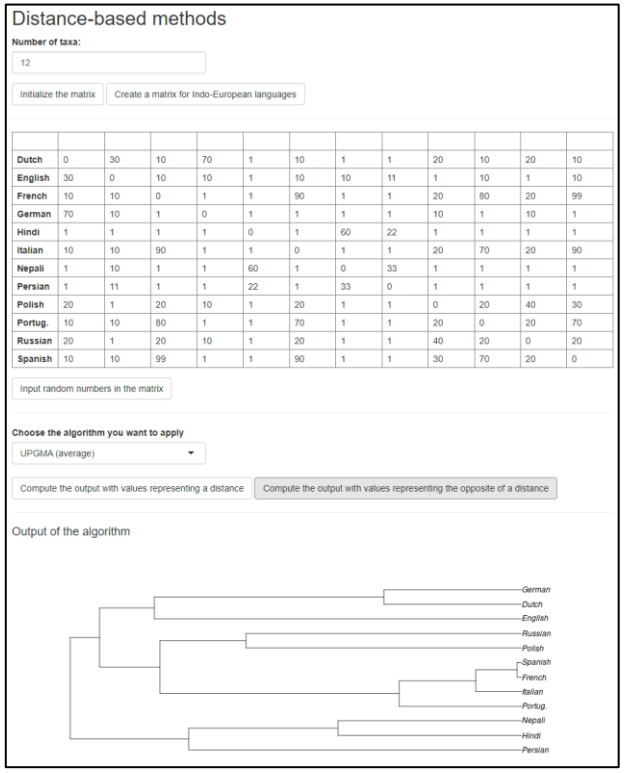


TEACHING DEVELOPMENT GRANT

15 online interfaces to ‘flesh out’ the exploration of various areas of linguistics

TEACHER’S PROGRAMMING





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Developing even a simple interface can participate in enriching a T&L activity

- Make an activity more original, situated, engaging, collaborative etc.

Greater flexibility *without the hassle*

With the TAME interface, students can currently choose between a number of text corpora

- Adding a new resource is possible, but currently requires slightly modifying the code

In progress: tapping into Project Gutenberg's online database of over 60,000 ebooks

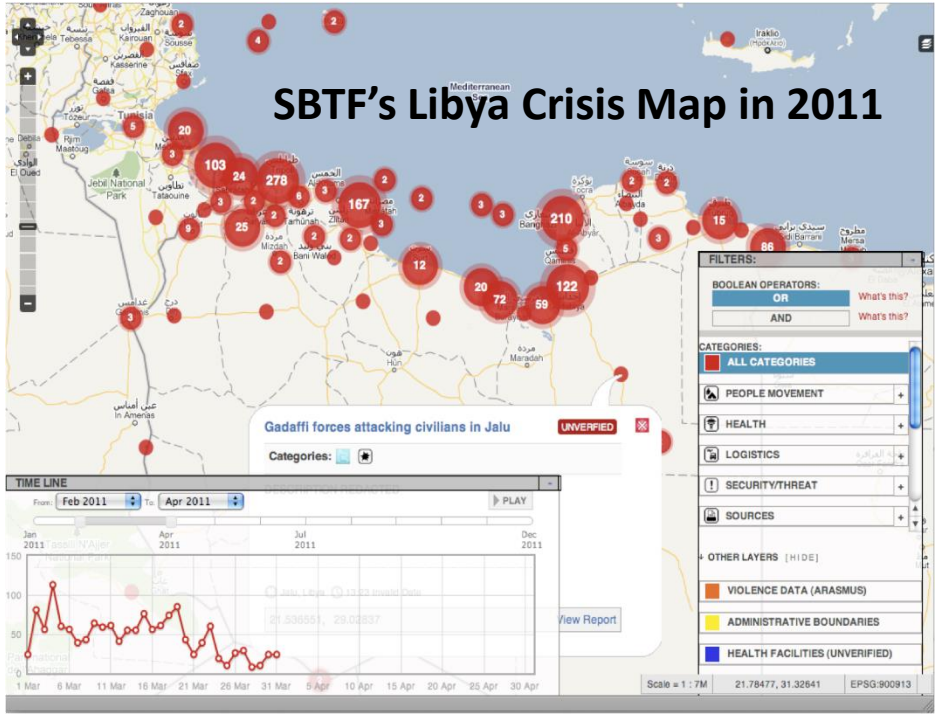
- Allowing users to quickly add text resources by themselves
- A student can choose the book they want to study
  - More flexibility, more agency, more engagement
- The teacher does not need to get involved, and grading becomes even more varied ☺

Building collective maps

Have students experiment with 'crowdsourced (online) crisis mapping'

- (CC course 'Digital Humanitarianism')

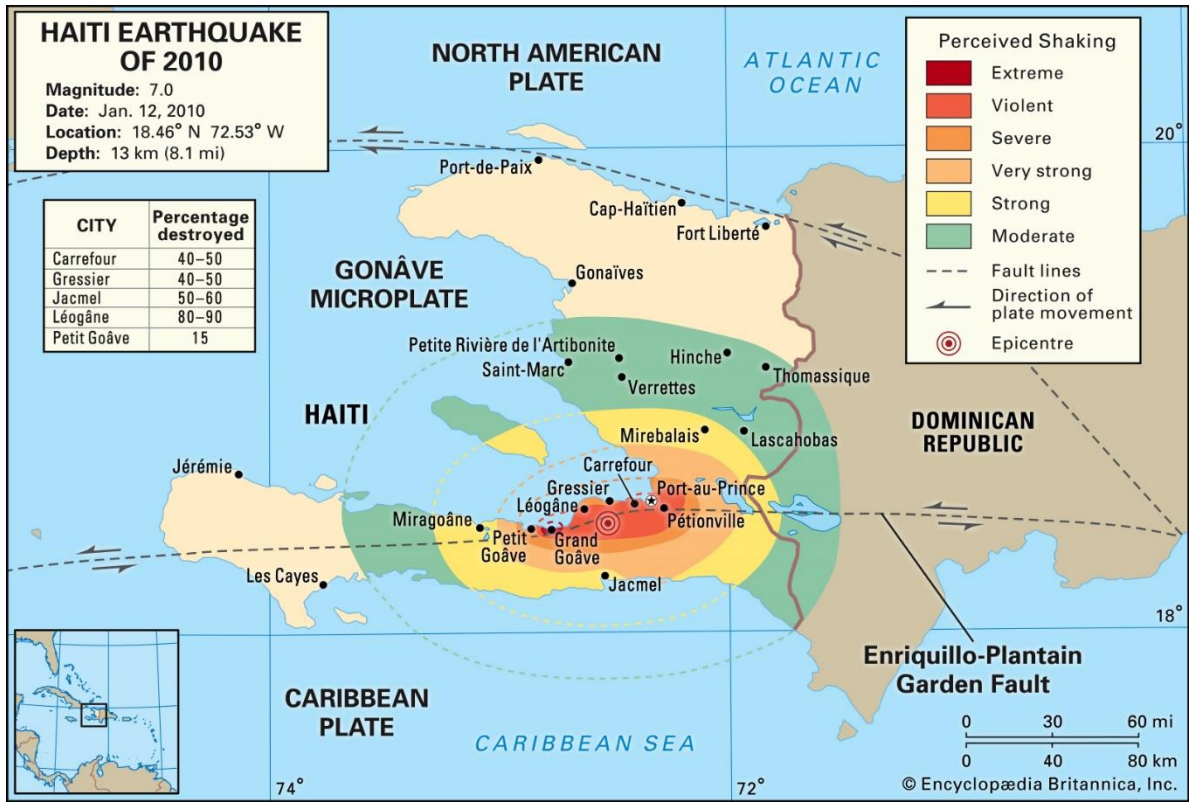
Objective: prepare accurate digital maps of a disaster-struck area with actionable information for rescuers 'on the ground'



https://www.standbytaskforce.org/2011/09/01/libya-crisis-map-report/

Situatedness: the 2010 earthquake in Haiti

January 12, 2010



People with desperate needs for various resources

- Food, water, medical supplies etc.
- Very severe emergency situation

First run of the activity

Provide groups of students with a text file containing a large number of SMS sent in the aftermath of the earthquake

- Actual messages sent in 2010 (sensitive information discarded for ethical reasons)

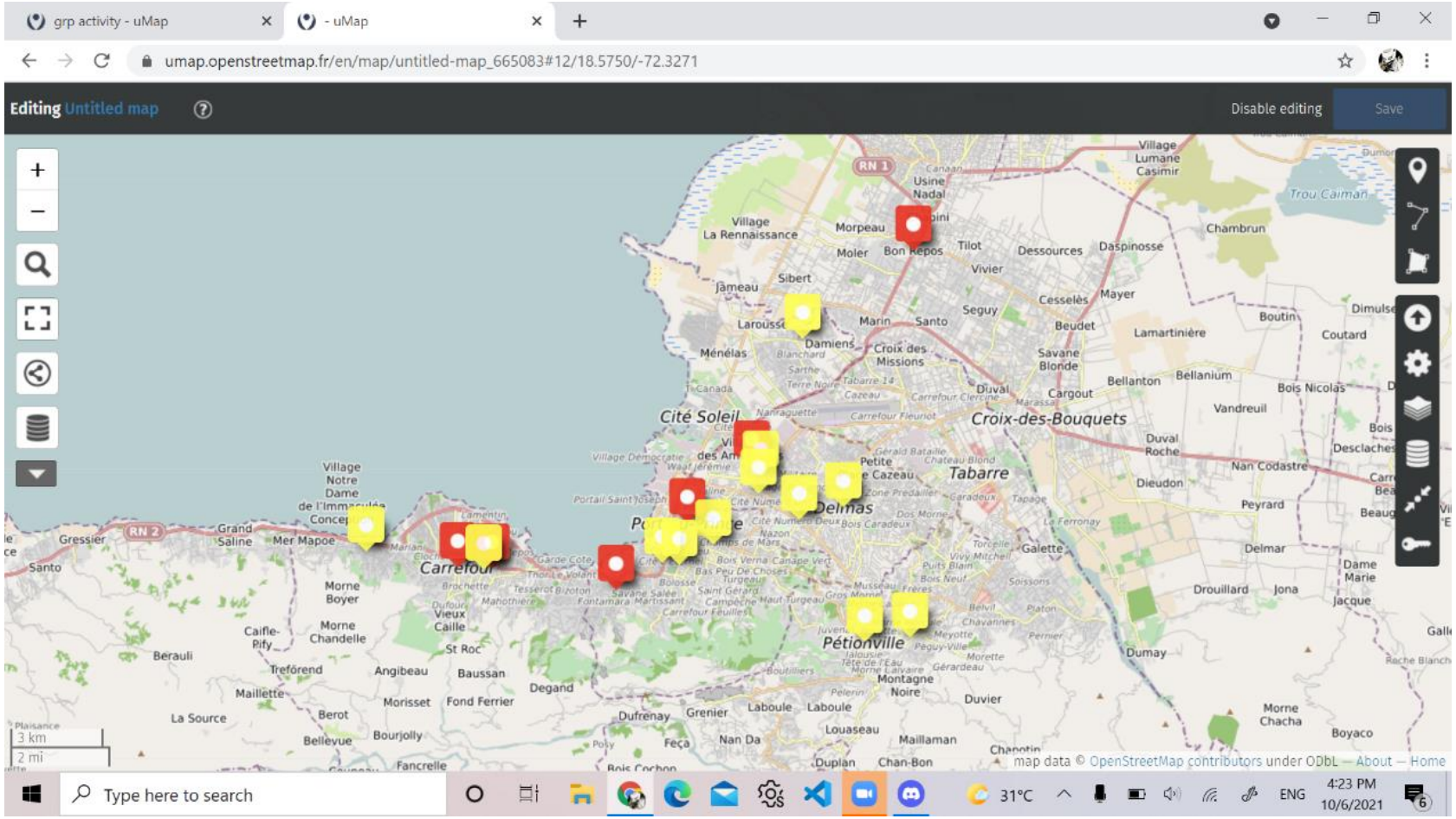
1. **Ask them to analyze these messages**
   - Distinguish relevant from non-relevant, actionable from non-actionable information
   - Categorize the various needs of the population

2. **Ask them to create an online digital map which could be useful to humanitarian field workers**

Flexibility in terms of approach and group work, hopefully original

Message
Weather update - a cold front from Cuba that could pass over Haiti
Is the Hurricane over or is it not over
says: west side of Haiti, rest of the country today and tonight
Information about the National Palace-
Storm at sacred heart of jesus
Please, we need tents and water. We are in Silo, Thank you!
I would like to receive the messages, thank you
There's nothing to eat and water, we starving and thirsty.
I am in Petionville. I need more information regarding 4636
I am in Thomassin number 32, in the area named Pyron. I would like to have some water. Thank God we are fine, but we desperately need water. Thanks
Let's do it together, need food in Delma 75, in didine area
More information on the 4636 number in order for me to participate. (To see if I can use it)
A Comitee in Delmas 19, Rue (street) Janvier, Impasse Charite #2. We have about 500 people in a temporary shelter and we are in dire need of Water, Food, Medications, Tents and Clothes. Please stop by and see us.
We need food and water in Klecin 12. We are dying of hunger. Impasse Chretien Klecin 12 extended (extension) We are hungry and sick.
I don't understand how to use this thing 4636.
I would like to know if the earthquake is over. Thanks
I would like to know if one of the radio ginen Journalist died?
I'm in Laplaine, I am a victim
There's a lack of water in Moleya, please informed them for me.
Those people who live at Sibert need food they are hungry.
I want to say hello, my message is to let you know that there's an area in faustin Anhy street that has nothing neither food, water and medicine,
Can you tell me about this service
How can we get water and food in Fontamara 43 cite Tinante?
We need help. Carrefour has been forgotten completely. The foul odor is killing us. Just letting you know. Thanks!!
Good evening, Radio one please. I would like information on Tiyous.
We have a lot of problem at Delma 75 Avenue Albert Jode, those people need water and food.
I'm here, I didn't find the person that I needed to send the pant by phone
People have been sleeping outdoors in a field near Lilavois since 12 Jan. No coords on Lilavois but apparently it is near PaP
We want you to know that Carrefour need help, we starving to death.
I would like to get help at Cote Plage in Carrefour
I am in Leoganes, where can I get food? Please
The Comite Miracle in the area of Alerte Rue Monseigneur Guilloux, (Streets, Alerte and the cross street is Mgr Guilloux) would like to urgently receive food, water and tents for the people in that area. Thanks
People from Dal blocked since Wednesday in Carrefour, we having water shortage, food and medical assistance.
In Jacmel it's not working at all, because people are dying of hunger.
We have no one everybody is dead.
We don't talk about Petit-Goave, Please, look into Petit-Goave.
People in Fontamara 27 in impass area Pierre Louis having lots of difficulties, please help, ASAP.
Good evening, I congratulate you for all the good work and with strenght i'm listening from Matisan 1, we have water and food shortage but God provided his grace

Resulting maps



Next runs

Add some ‘spice’ to the activity

Messages are not sent in bulk, but delivered in a manner closer to what early crisis mappers faced in 2010

- Strong and clear time constraints
- Overload of information (compounded by the time constraints)

Forces students to better distribute tasks in the groups

- More collaborative, more engaging

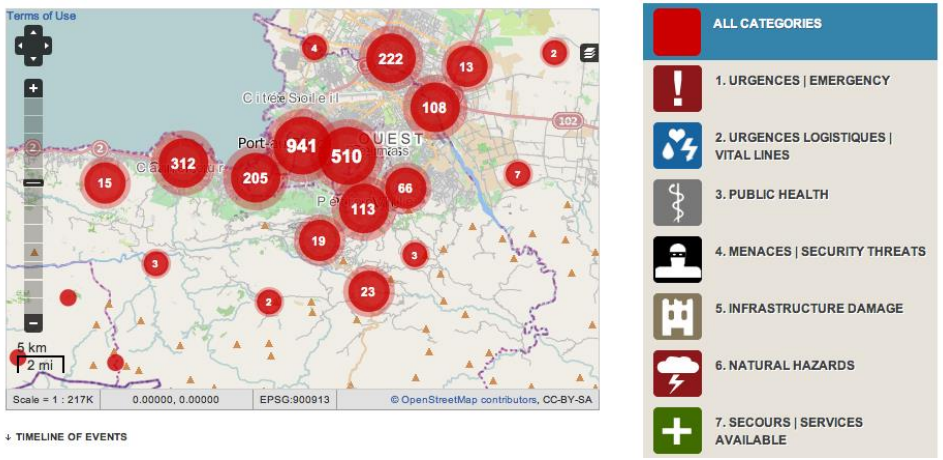
A component among others (1/2)

The interface impacts the activity, but is only one of its components

Other components to meet the COFFEES design principles

- All student groups submit their maps – the best earn a small bonus
- Collective feedback on the different maps, discussion about various approaches (sharing the workload, designing the map), comparison to the original map

Original map

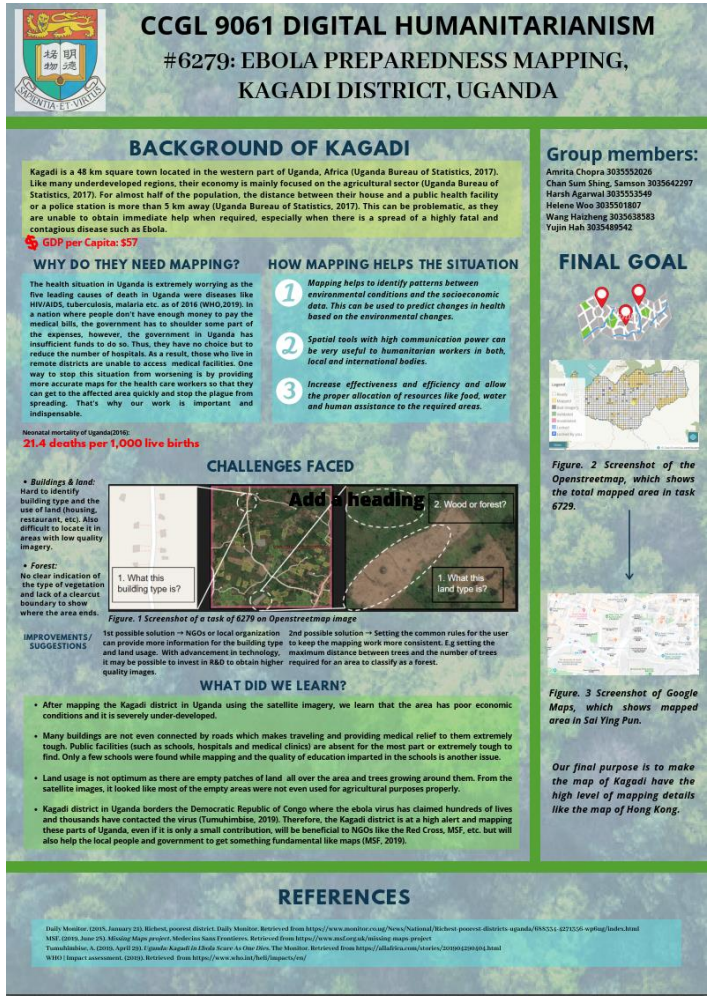


https://irevolutions.org/2011/03/06/changing-world-map/

A component among others (2/2)

Other components to meet the COFFEES design principles

- Students further participate in online humanitarian mapping projects, and report their work
  - Choose their own projects (flexibility)
  - ~400 hours each year to support humanitarian organizations
  - **Concrete, impactful, empowering contribution**
  - **'Hardware, Software and Heartware'** (Dr Nason Tan, MSF HK)



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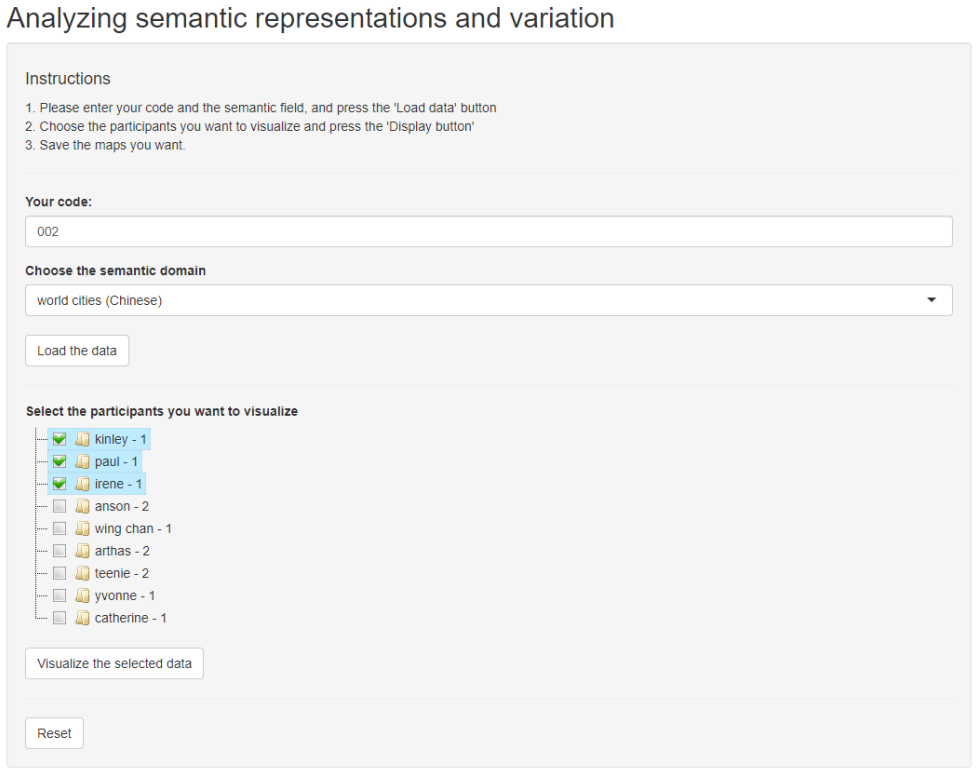
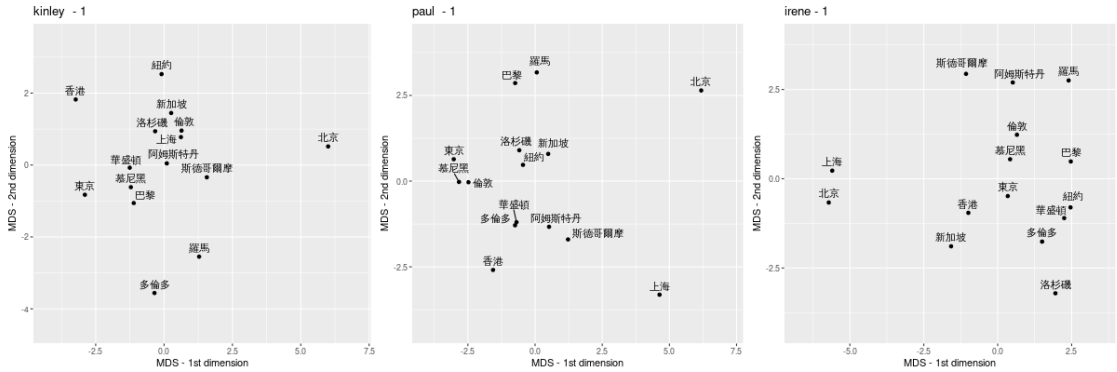
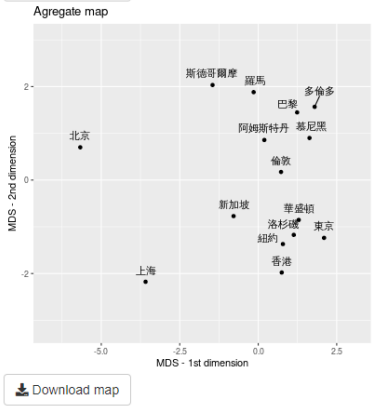
One may feel software interfaces can only relate to techniques, experiments, hard science etc.







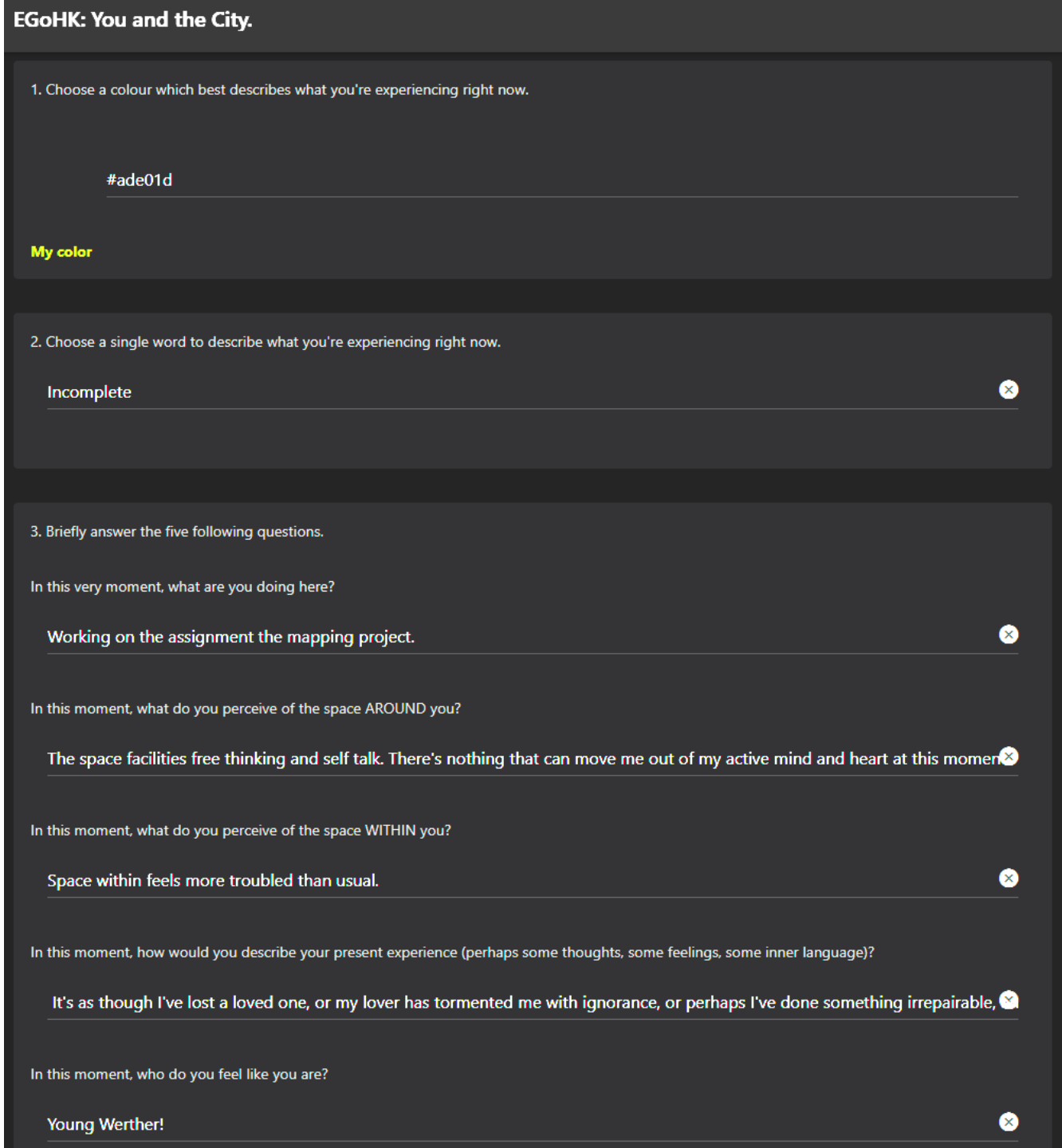
However, one may also touch upon human experience

Tools to *access* and *question* subjectivity, perceptions, feelings, emotions

The EGoHK Project (Experiential Geography of Hong Kong)

CCGL9061 – Digital Humanitarianism

An online platform, accessible through mobile phone, to collect data on students' lived experience (https://keruiduo.shinyapps.io/egohk/)



The EGoHK Project

Strong guarantees of anonymity and absolute freedom in choosing what to report

- Flexibility

One's own intimate world to be shared

- Engagement, situatedness

After data collection, groups of students create video reports on their experiences and their participation to the project

- Collaborative work, empowerment
- Feedback by the teacher & the TA

In this moment, who do you feel like you are?

"Just a normal university student" (very common)

"A bird happily chirping in the early morning"

"A fish being pushed by the waves, unable to find its way"

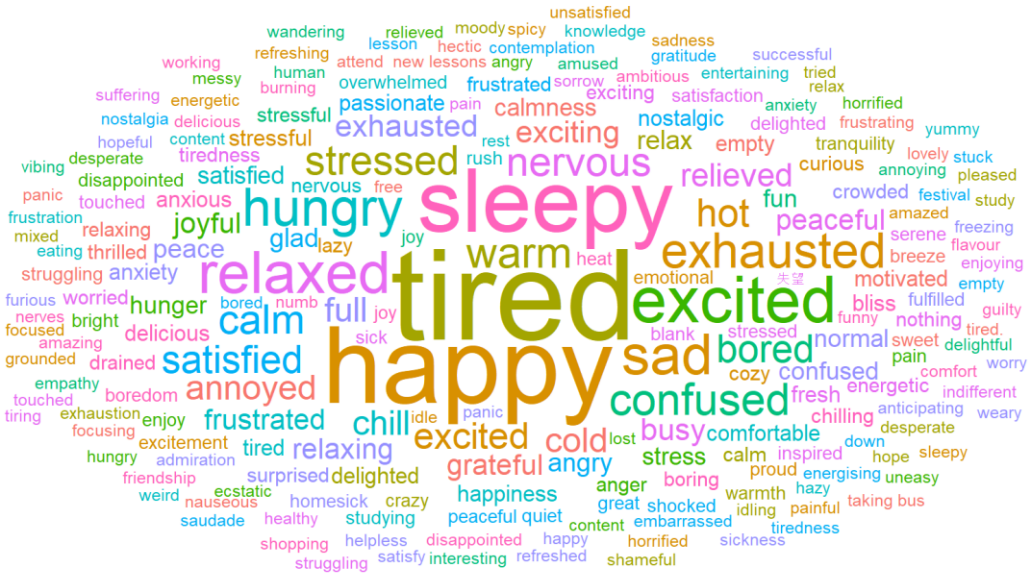
"Aristotle before his death"

"An ant on the hot pan"

"Not the best version of me"

"A self-absorbed being who is throwing all the stress away on the EGoHK interface for self-soothing"

What does it mean to be a student in Hong Kong?



Students' single-word descriptions of their experiences

Experiences on HKU campus (several days seen as one, from 8am to 8am)

Once again, a piece of software as a component of a more holistic approach promoting agency

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The various pieces of software introduced previously primarily support T&L

They can also promote research and art

Back to the EGoHK project

The data collected during the project can be analyzed to answer different questions

- *Do emotions and experiences associate to specific colors?*
- *How does time affect subjectivity?*
- *Are some locations in HK more associated with positive or negative emotions?*
- *What is the range of experiences lived by students?*

Use of data science and text-mining techniques

Partnership with Chan Kwan Kin (Ken) (undergraduate student)

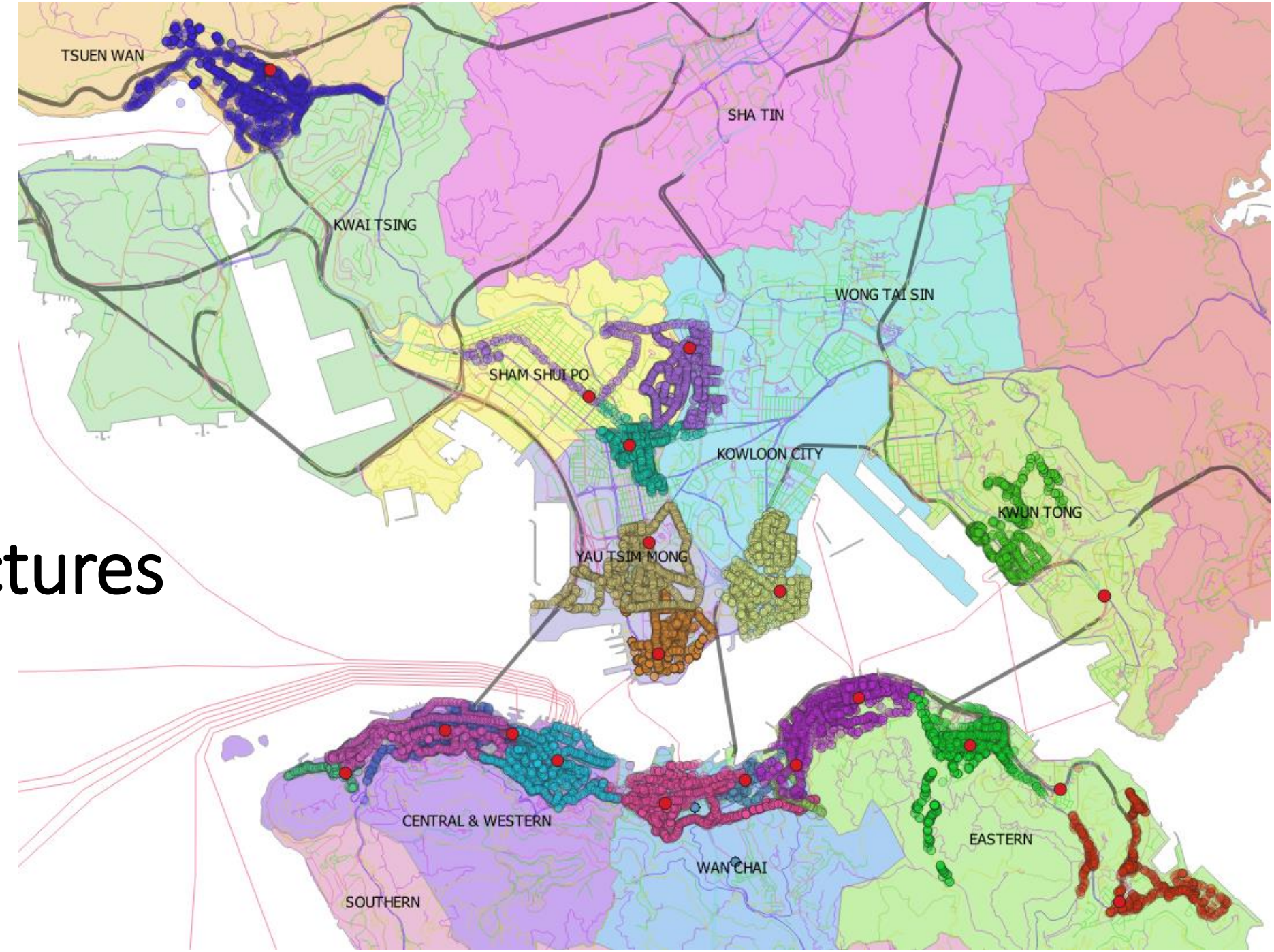
The HK Streets walkability project

A project to better understand how easy it is to walk in various areas of Hong Kong (digital humanitarianism)

Students took pictures of areas around MTR stations - one picture of the sidewalk on each side of each street every 25m

A LOT OF pictures

> 18,700 geotagged pictures (and some others without the tags…)



Investigating walkability

The students pondered over the various factors impacting walkability

- Especially for young children, elderly

They also participated in a pair judgment task for a selection of 3,000 pictures, thanks to a dedicated interface

- Around 43,000 pair judgments, used to compute a walkability score for each pic

They prepared a video report on walkability, their reflections and their participation to the project

On-going research

Shift from the 3,000 pictures to the full set of pictures

Deep learning methods to learn what impedes or favors walkability, and then predicts walkability as accurately as possible

- Transfer learning with networks pre-trained on street pictures for image segmentation

Analyze walkability at different spatial scales and time periods

→ Leveraging the students' involvement

A more artistic T&L activity

Some awesome and free software is already available online!

E.g., deep style transfer to work on visual communication

- https://deepdreamgenerator.com/

Students are tasked with creating an interesting image about humanitarian action and humanitarianism

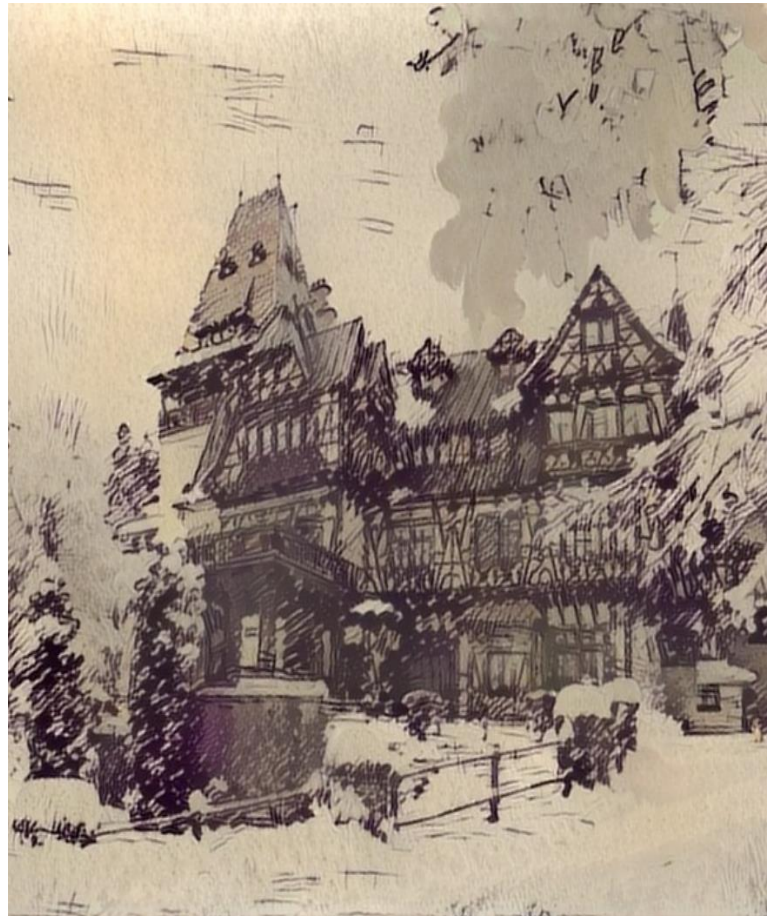
- Plus write a short meaningful description/explanation of their image

Images are peer-reviewed, commented and voted by the whole class

Deep style transfer

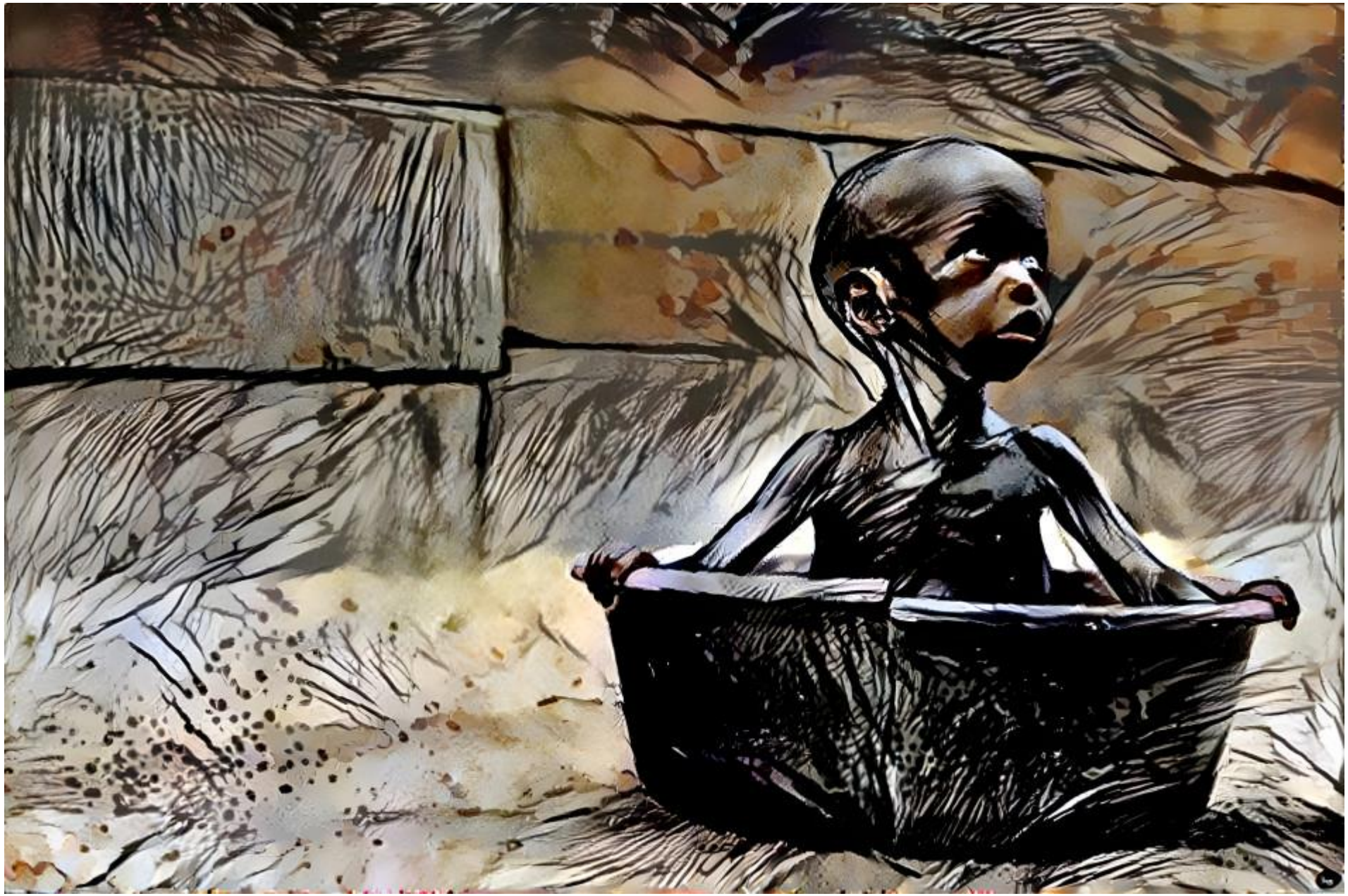
Deep-style transfer is a technique to blend the surface / style of an image with the content of another one

Allows to create interesting / surprising / artistic images



Febrina Audrey

‘A child in conflict-torn Chad walks past a wall with drawings of rocket-propelled grenade launchers. He imagines what life below water looks like: with teeming coral reefs, and blue whales instead of grenade launchers travelling in pods. His imagination and his hope for peace keep his uneasiness at bay.’



Ho Kin Ling

Kwong Hoi Shan

Leung Si See

Maydeline Fonda

Ip Wing Yi

Conclusions (1/2)

Software interfaces can support and enrich teaching & learning

- Create better-rounded experiences and promote agency
- Any topic may benefit from the development of T&L digital tools

These tools and their design can co-evolve with the broader pedagogical process

Beyond T&L…

- They can form the basis of research projects
- Art and creativity can be considered along the way

Conclusions (2/2)

I am confident that the software I have shown you benefit my students

- Scholarship of T&L, students' evaluations and detailed comments, my own perceptions in the classroom

Is it for everybody?

- I like building digital tools, and I am an experienced programmer → easier for me, and less time-consuming
- But one can partner with programmers and provide specifications (e.g., with a TDG grant)
- The tools do not need to be very complex to be effective!

A meaningful mid- to long-term investment

- Developing an interface can take time
- But it can be used by hundreds of students if used over the course of a few years
- Once ready, it actually saves time for both the students and the teacher