Landmarks for accessible space – promoting geo-literacy through geospatial citizen science

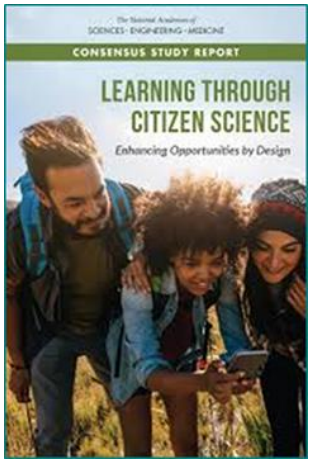
Dalit Lan, Ayelet Baram-Tsabari, Sagi Dalyot

Technion
Israel Institute of Technology

MAPPING & GEO INFORMATION ENGINEERING

Geographic citizen science

- Citizen Science is a scientific research conducted by the citizens, in collaboration with scientists or under the management of scientists and scientific institutions (Oxford, 2014).
- Geographic Citizen Science includes activities involving the use of geographic information technologies (Skarlatidou & Haklay, 2021).

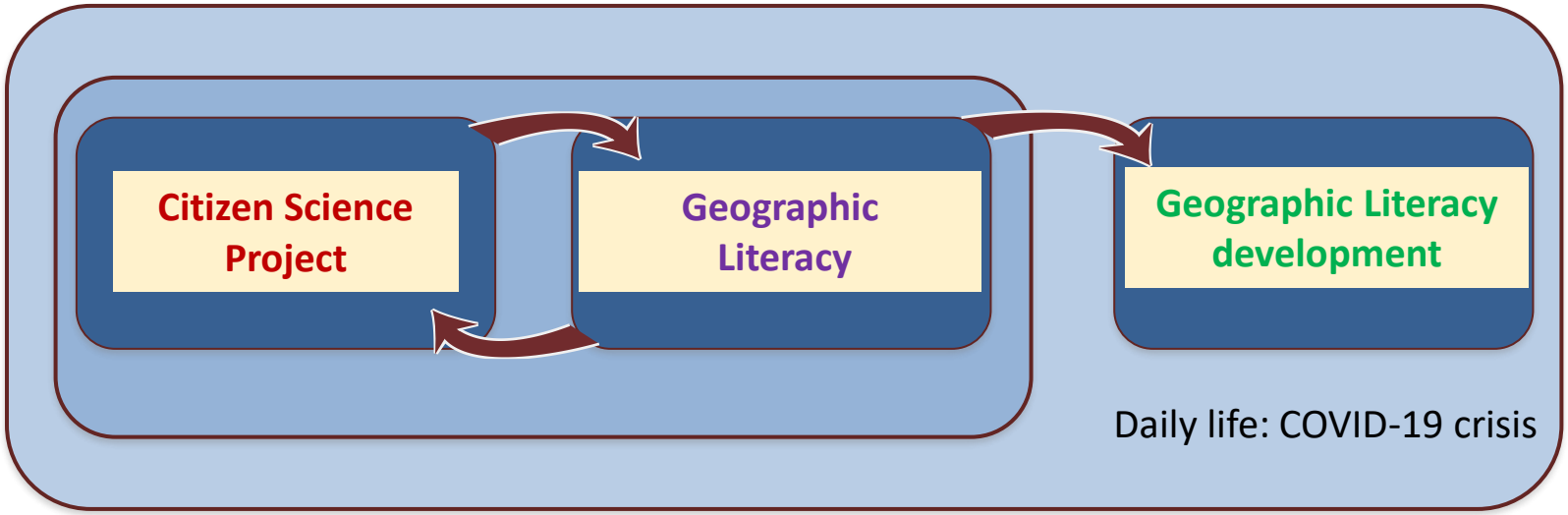


Geographic literacy

- The ability to use knowledge, skills, and reasoning, for the interpretation of spatial/geographical phenomena, their extent, and relations (Bednarz & Lee, 2011 ; Kastens & Ishikawa, 2006).
- The ability to use geographic understanding and geographic reasoning to make decisions and to answer spatial geographical questions:
  - Knowledge (incl. factual knowledge), skills, perspectives (e.g., ecological), dispositions thinking, and Values. (Maclachlan et al., 2014; Moorman, 2019).
  - Interactions, interconnections, and implications (Dolan, 2019).

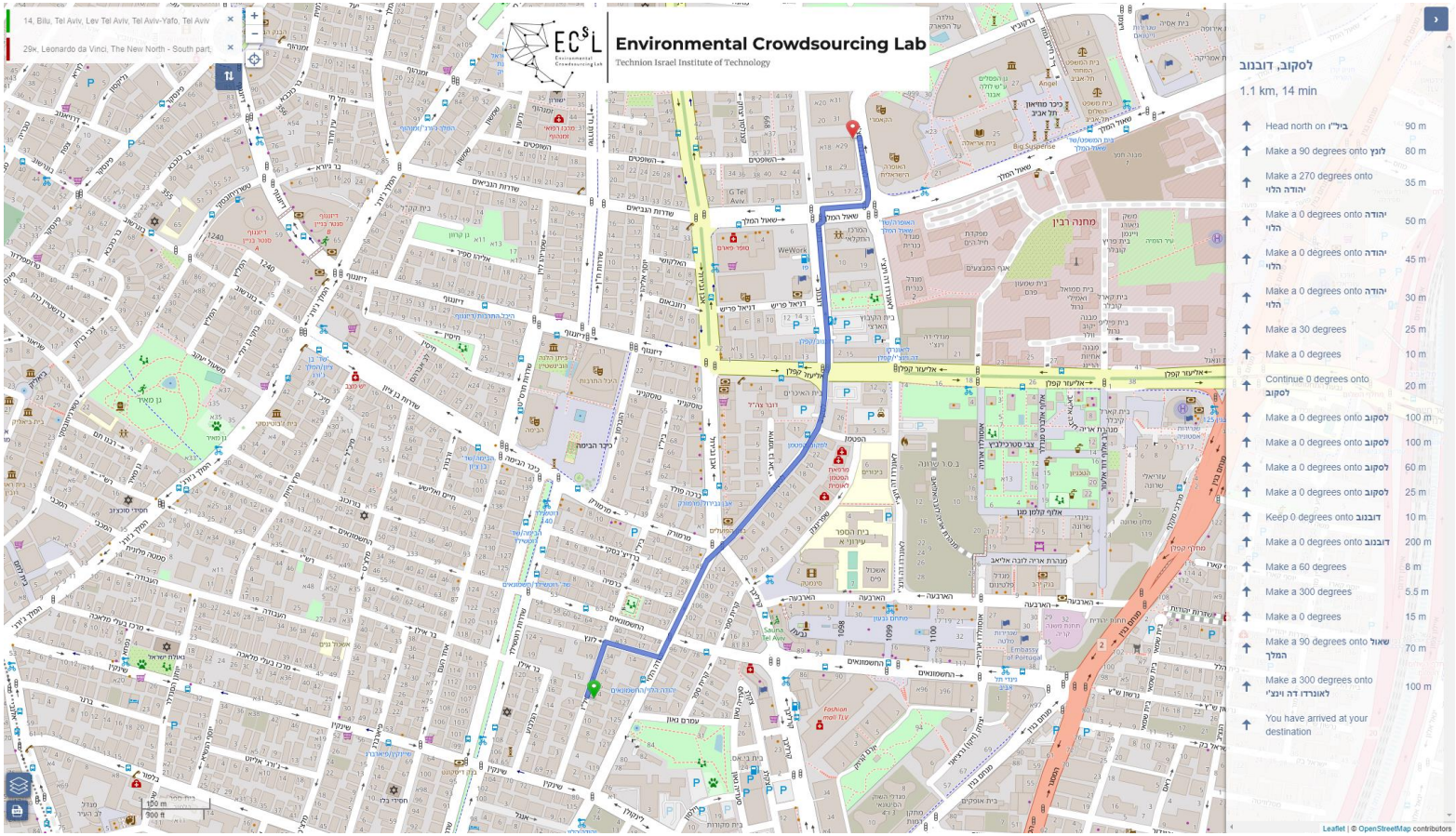
Landmarks for accessible space

- Gain a better understanding regarding the development of geo-literacy in the framework of a participatory mapping citizen science project in schools, contribution to daily life.
- Students edit OpenStreetMap, e.g., map obstacles, in their local environment, where this data is used for the automatic calculation of safe and accessible walking routes for visually impaired pedestrians.



Landmarks for accessible space

- Route planning for visually impaired pedestrains (Cohen and Dalyot, 2020, 2021).



Landmarks for accessible space

Research Tools

Pre and post questionnaires examining the integration of citizen science in schools.

Participant observation.

Mapping data analysis.

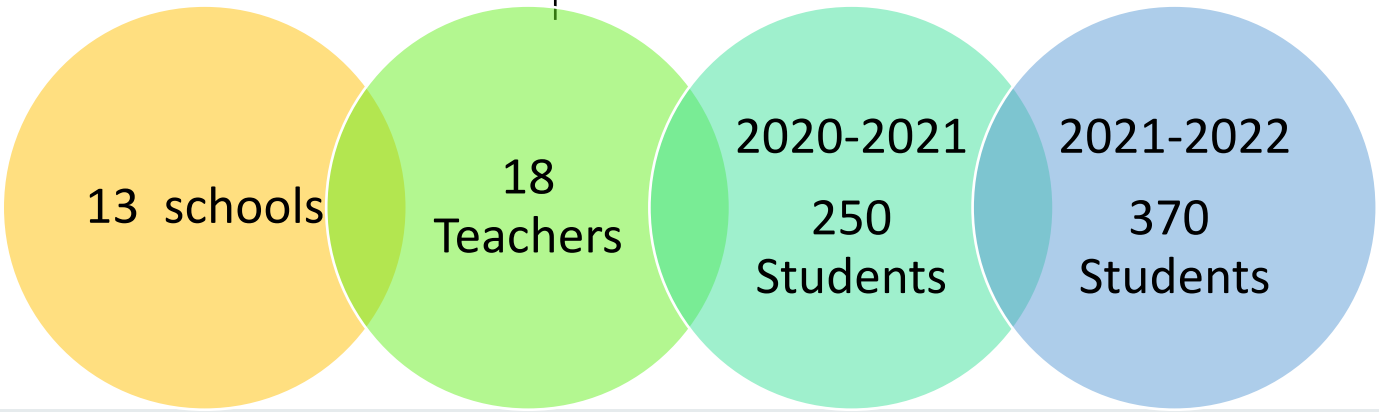
Semi-structured interviews with students.

Participants

Students (9^{th}-12^{th} grade):
preliminary research: 20 students

Iteration A: 250 students from 3 different schools.

Iteration B: 370 students from 10 different schools.



* > paired

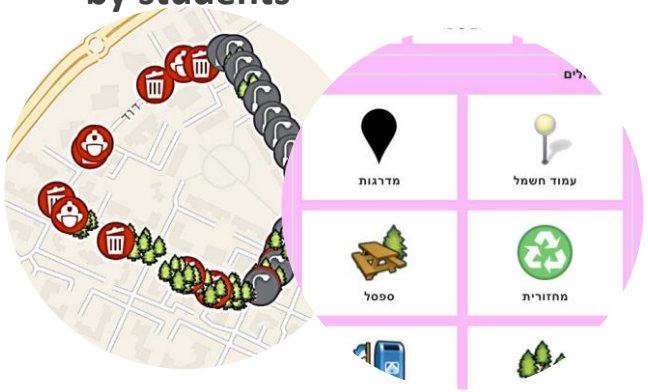
Landmarks for accessible space

- Design of modular learning environment.
- Design the program implemented by the teachers - creating different citizen science in school models (a part of the Taking Citizen Science to Schools initiative).
- Teachers WhatsApp group – sharing educational materials, advice, and experiences.
- Development of the “Mundi” app for OSM mapping.
- Guest seminars (including YouTube videos), lectures and learning activities.

Landmarks for accessible space

Mapping with Mundi

Mobile app developed by students

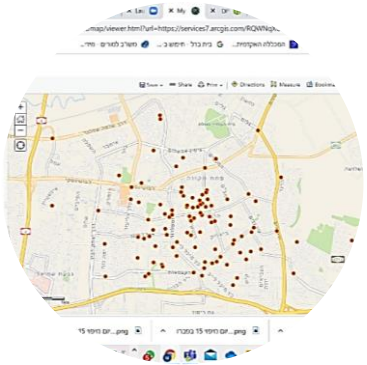


Making the world more accessible to individuals with visual impairments

Seminars at the Technion

Assignments

Accessibility survey

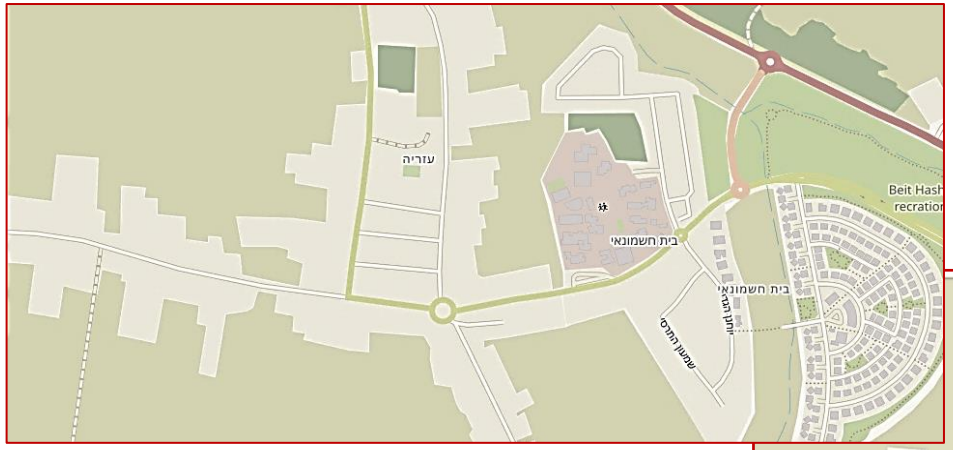


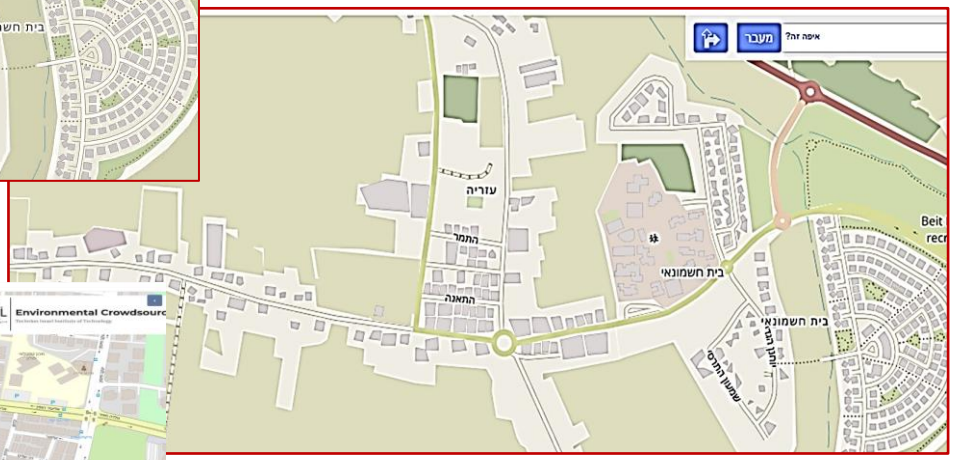
Data analysis ARCGIS

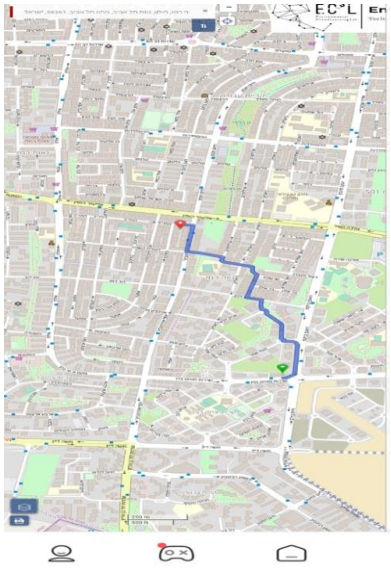
Research of pre-/post- routes

Digitization of buildings

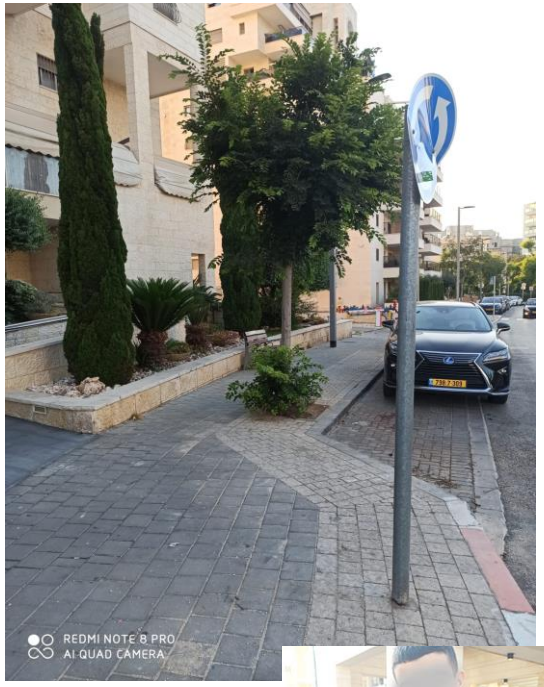
Landmarks for accessible space

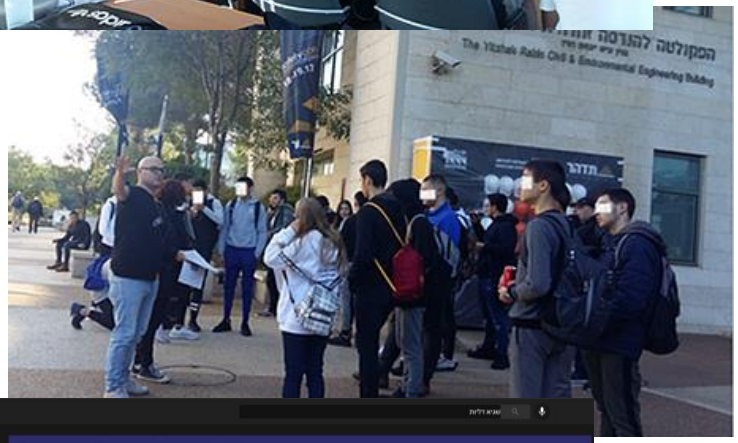


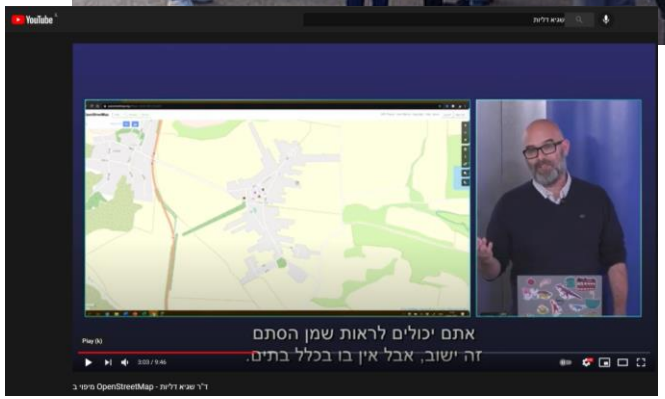


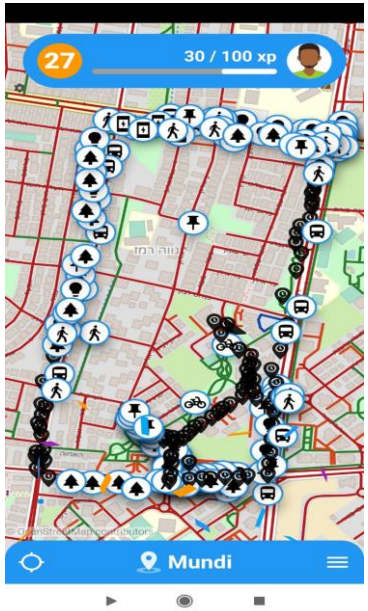


Landmarks for accessible space



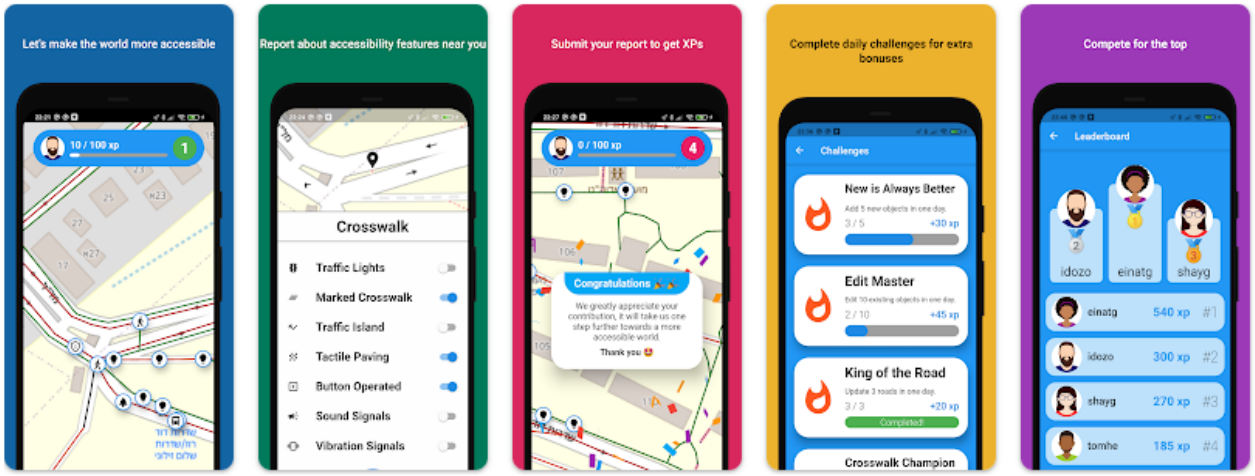




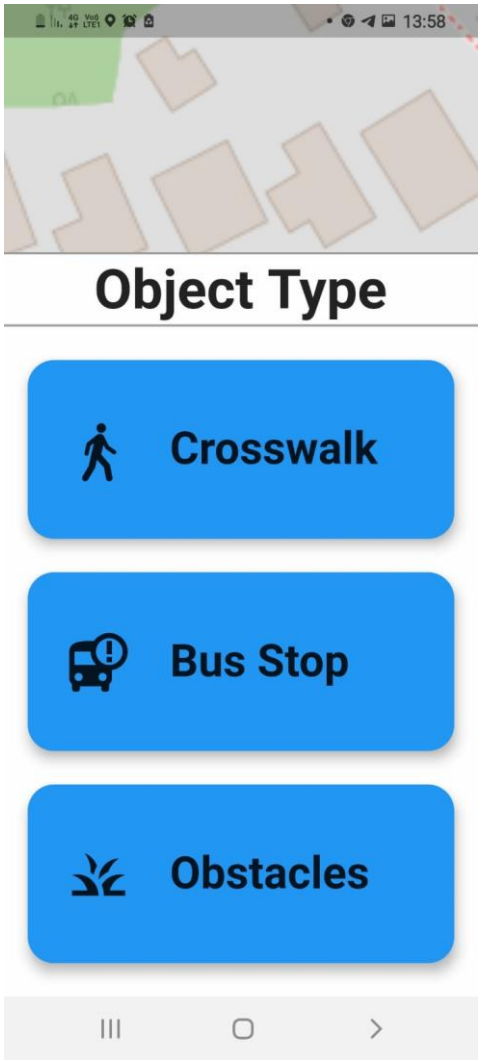


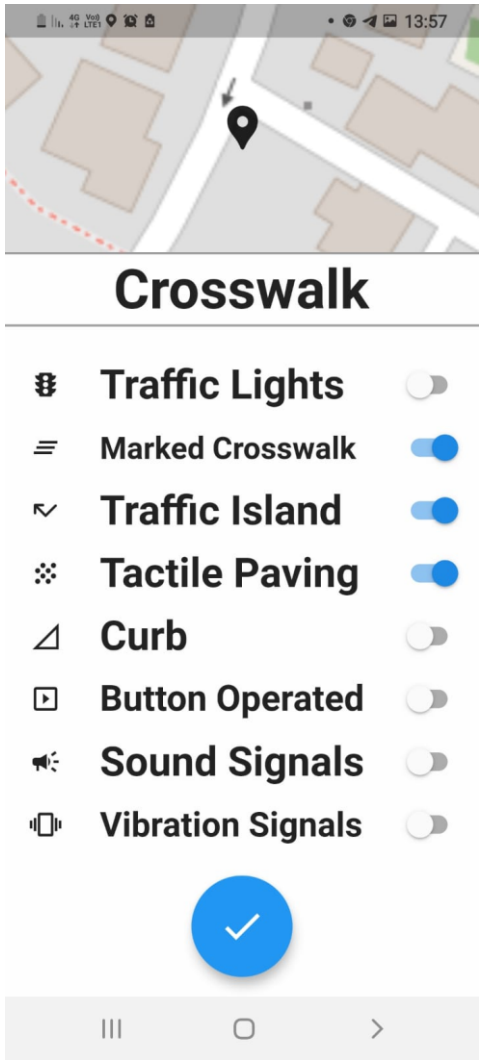
Landmarks for accessible space

- “Mundi” app allows the mapping of specific geographic features (mapping elements) used in the calculation of routes.
- The features include, among others, sidewalks (as tags), crossings (incl. tags), and accessibility aids.
- The app includes gamification and tasks to encourage the students to map the missing features in their area of residence.

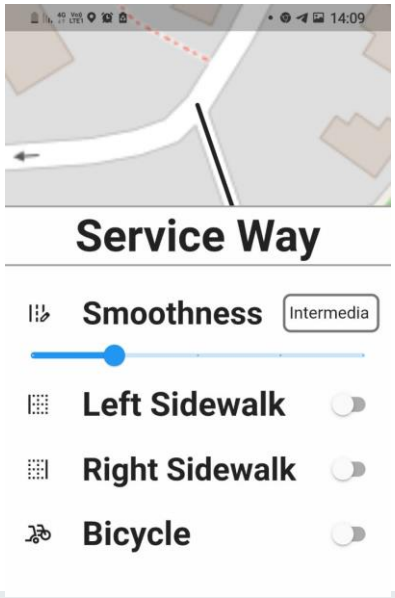


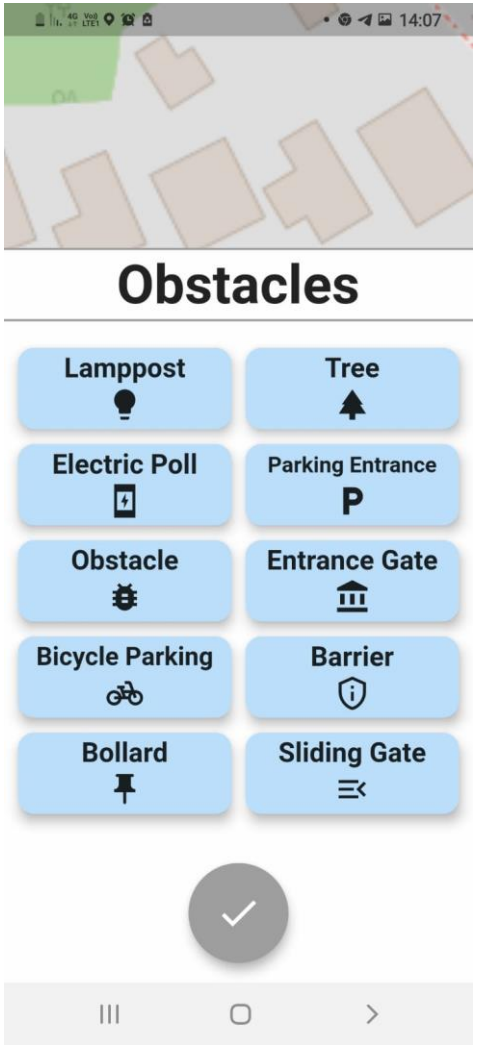
Landmarks for accessible space



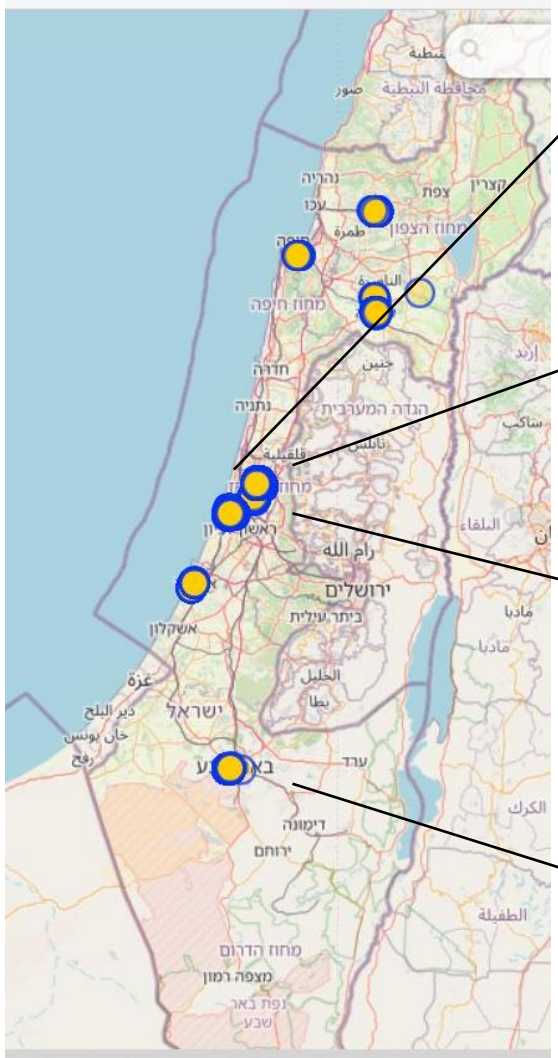


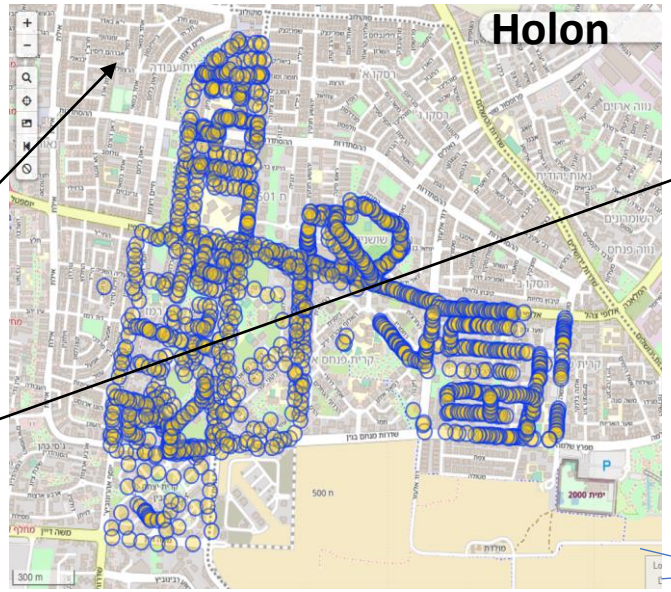
Landmarks for accessible space

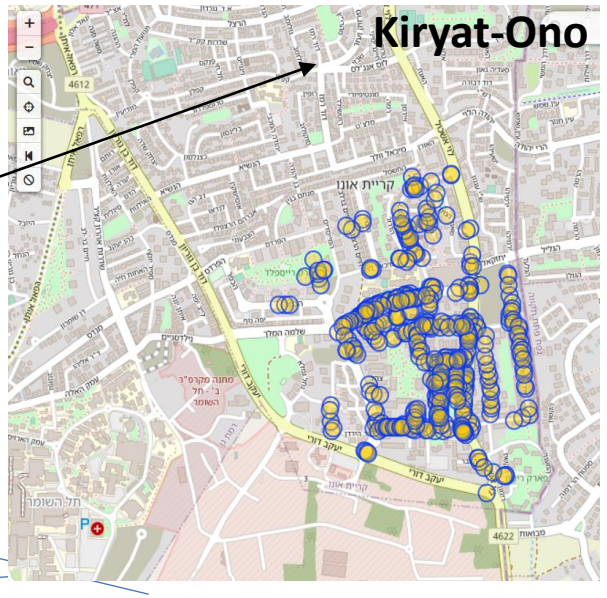


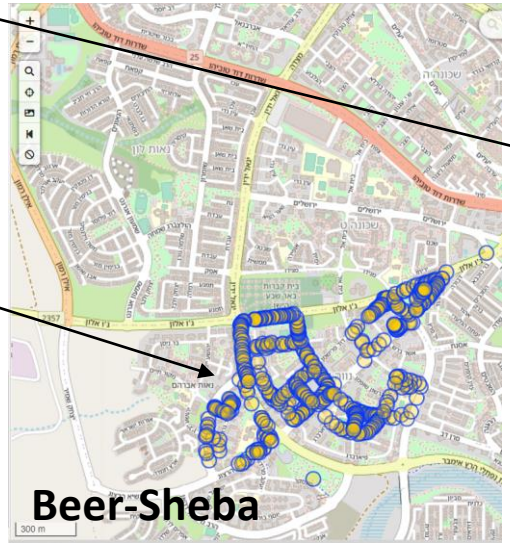


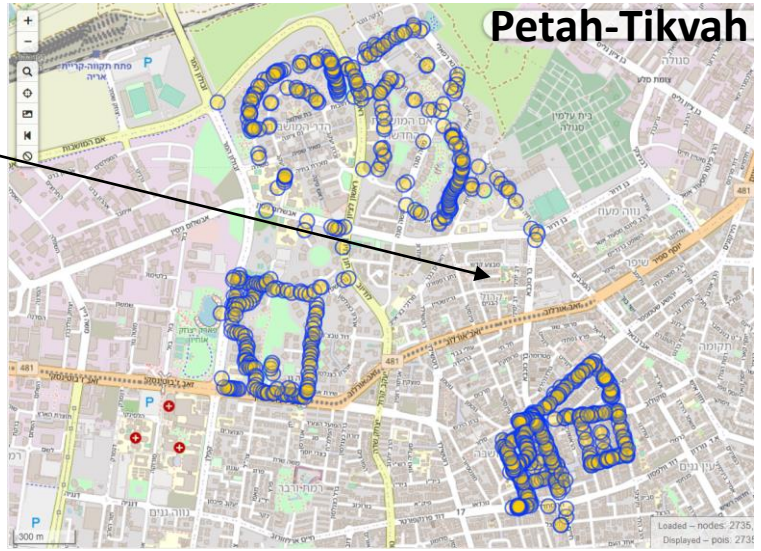
Results



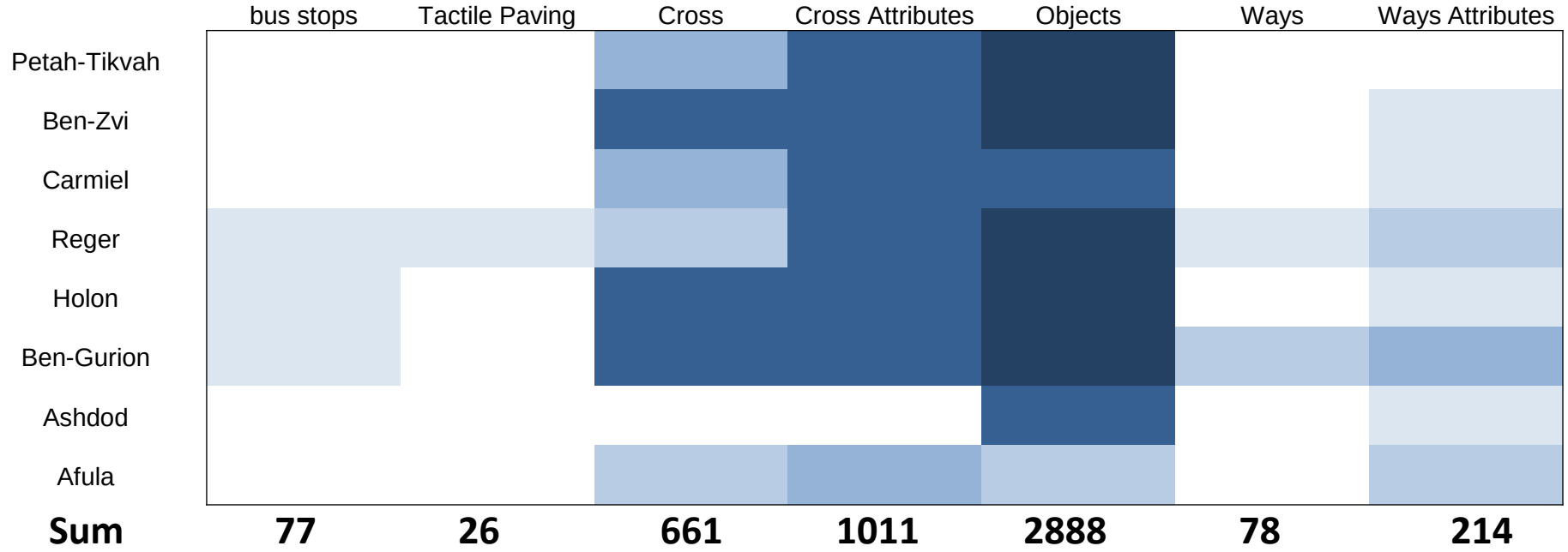


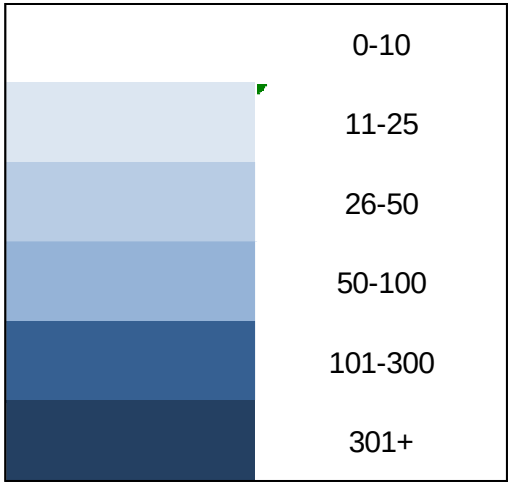






Results

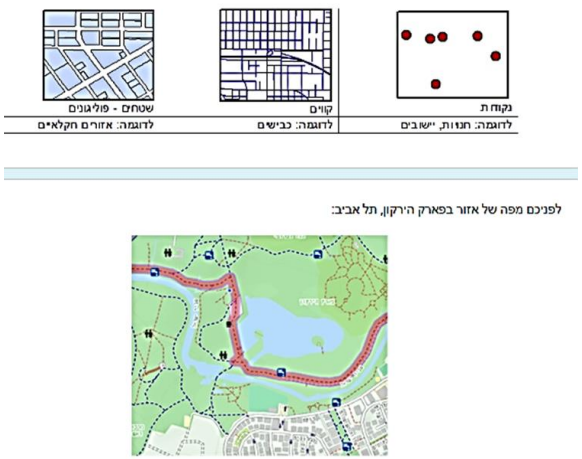

bus stops
Tactile Paving
Cross
Cross Attributes
Objects
Ways
Ways Attributes
Petah-Tikvah
Ben-Zvi
Carmiel
Reger
Holon
Ben-Gurion
Ashdod
Afula
Sum
77
26
661
1011
2888
78
214


0-10
11-25
26-50
50-100
101-300
301+

Results

Analyzing Geo-literacy variables, e.g.:

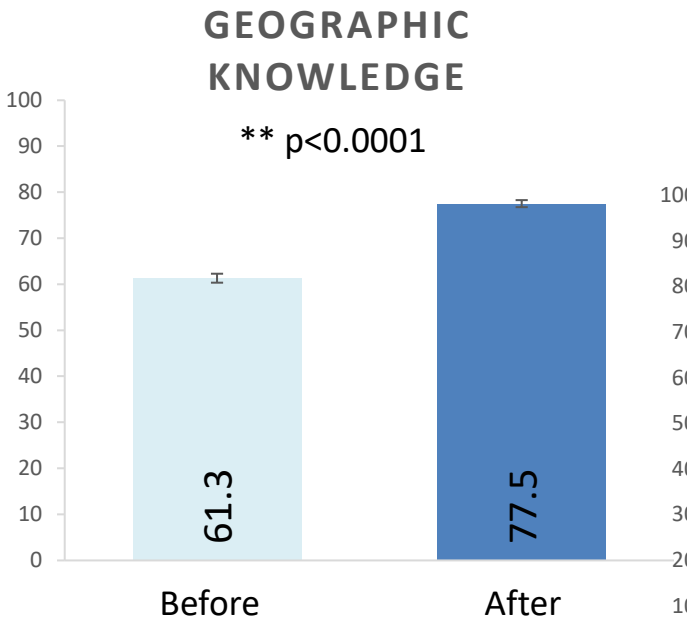
- Declarative (factual) geographic knowledge - identifying countries on a map.
- Geographic skills - map symbols representation and identification, interpretation of scale.
- Spatial thinking – wayfinding and navigation assignments.

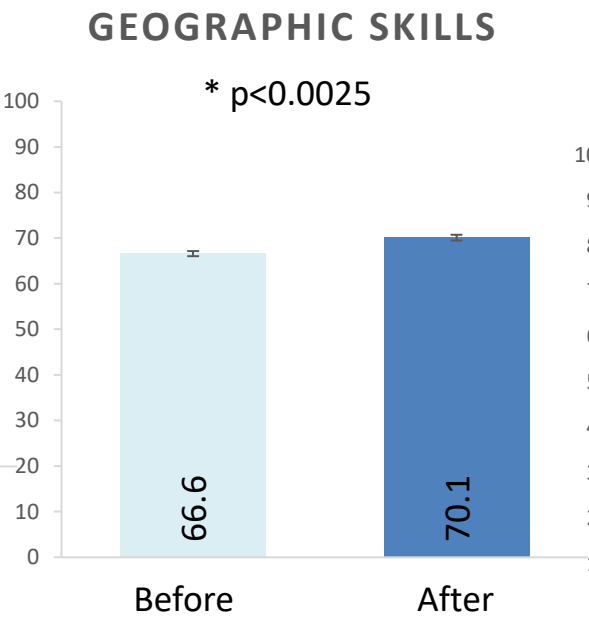


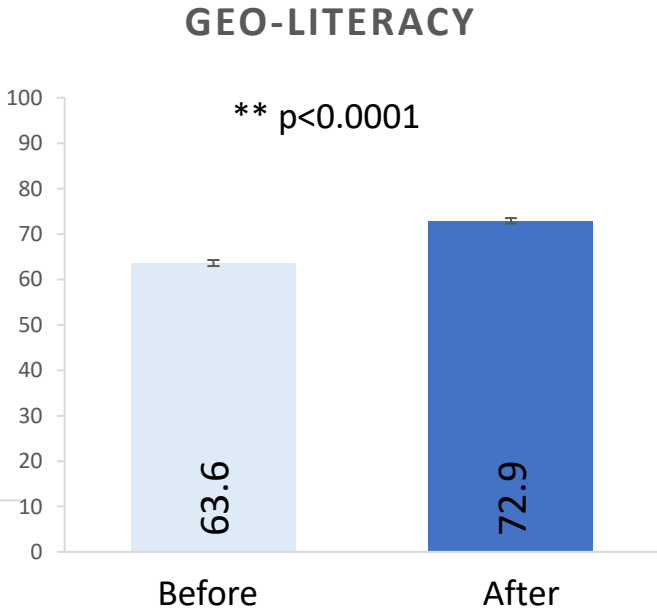
The Spatial Thinking Ability Test (STAT), Lee & Bednarz (2012)

Results

- A positive difference was found between before and after the intervention for all the variables examined.
- No significant differences were found between schools.





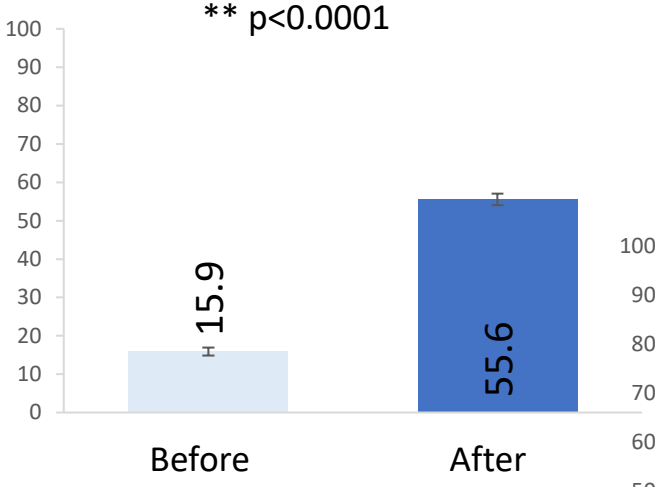


paired samples, t-test

Results

SCIENTIFIC THINKING

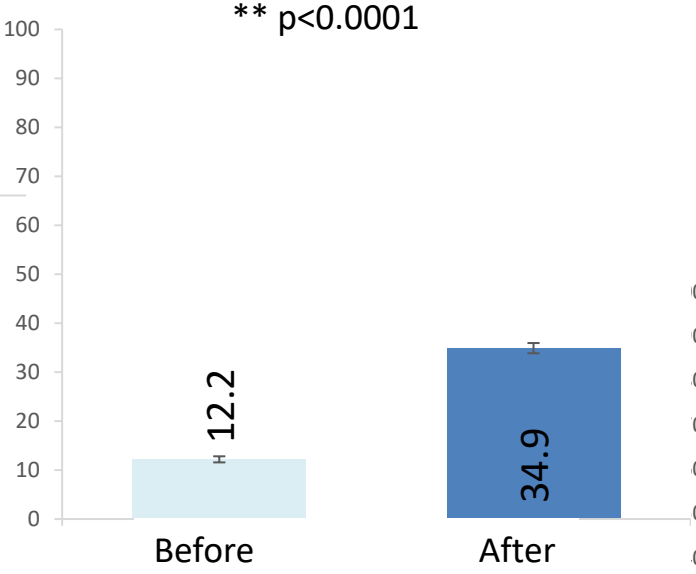
** p<0.0001



paired samples, t-test

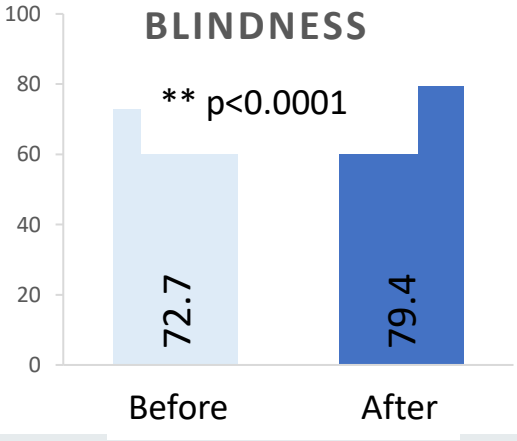
SPATIAL AWARENESS

** p<0.0001



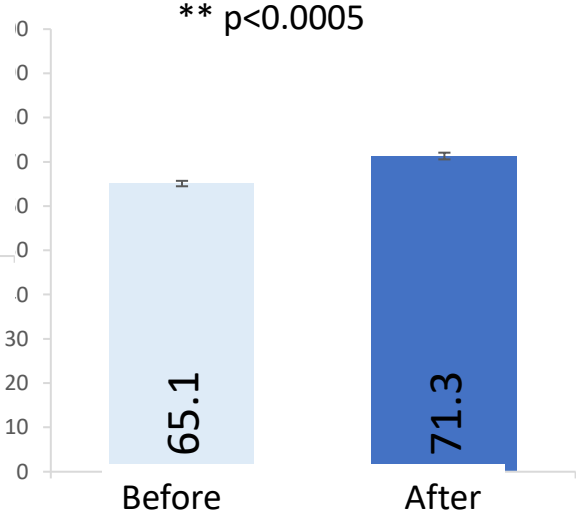
KNOWLEDGE BLINDNESS

** p<0.0001



SPATIAL THINKING

** p<0.0005



Results

- Daily life: examining the geographical literacy of students in the context of the COVID-19 pandemic.
- 640 students (9^{th}-12^{th} grade), where 162 participated in the project.
- A difference (in geo-literacy) was found:
  - Participation - Md = 67.50, M = 66.85, SD = 14.46
  - Non-participation - Md = 60.00, M = 59.73, SD = 16.23
  - t(308.86)=-5.25, p<0.001

Conclusions

- Student: "We mapped the Neve-Remez quarter in two rounds in two days… four hours and forty minutes… it was quite difficult. Before the work, I didn't exactly understand how the project might help us and the blind and in what ways it could help. After we did the work, **I realized how important the project is and its contribution to society in general and to blind people in particular, and how important it is. I'm glad that I took part in the project …it gave me a lot.**"
- Teacher: "The mapping with the app was the most important practical means… students enjoyed it. …the practical work of going (there) and mapping.. **seeing the change in the field… seeing that the data they inserted are really in the (OSM) map… the mapping was the most interesting part.**"

Conclusions

- Mapping features and app:
  - Areas outside cities still required pre-mapping (streets and buildings).
  - In general, students preferred to map new point-features, mainly obstacles, that required no tag editing.
  - Mapping new crossing features that required also editing tags required a learning-process.
  - Ways that required spatial orientation (e.g., direction, topology) were less ‘favored’ map features to map.
  - The learning process affected the mapped features, i.e., students’ perspective of the most important features.
  - Mapping the same feature twice.

Conclusions

- Participation in the project was found to improve students' geo-literacy.
- The intervention increased students' appreciation of the scientists' contribution to the project, the contribution of the program, and their satisfaction in participating.
- Citizen Science projects in schools - that involves participatory mapping - was found to contribute to various pedagogic and education levels, in terms of theoretical knowledge about the integration of innovative geo-literacy programs.
- Lessons can be learned on actions regarding the planning of future projects and serving stakeholders in academia and the education system.

- **Planning customized routes (Israel)**

- **Mundi (Android) – community mapping (OSM)**

Thank you

Dalit Lan, Ayelet Baram-Tsabari, Sagi Dalyot

Technion
Israel Institute of Technology

MAPPING & GEO INFORMATION ENGINEERING