IDENTITIES

Enlightening
Interdisciplinarity
in **STEM** for Teaching

Computational simulations as
citizenship tools: a study with
university physics and mathematics
students

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2021 VIRTUAL ANNUAL MEETING
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- The widespread use of computational and data-intensive approaches is changing the ways of doing science and conducting research

- Simulations also impact society and decision-making processes

- They are complex tools which embed a variety of knowledge elements

- In the classroom very seldom they are analysed in their epistemological, methodological and societal aspect (Greca, Seoane & Arriassecq, 2015)
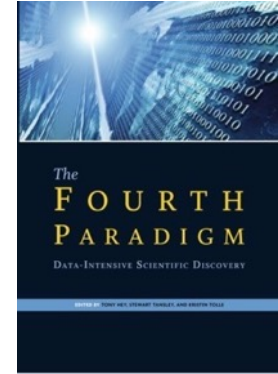
Consequences

1. **widening gap** between the current expert understanding about scientific simulations and knowledge of policymakers, citizens and students (Jacobson & Wilensky, 2006)
2. **mistrust attitudes** toward simulations and their results (Barelli, Branchetti, Tasquier, Albertazzi & Levrini, 2018)

How can science education guide students to recognize simulations as authentic scientific tools and to develop action and decision-making skills?

THE STUDY

- March-April 2020, online

- 50 Physics and Mathematics master students enrolled in the course of Physics Education
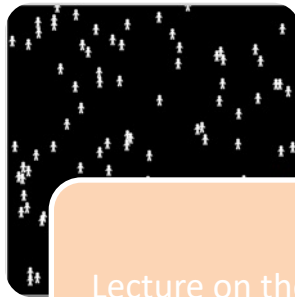
Lecture on the model for the spread of a virus

Analysis of a simulation on opinion dynamics (Axelrod model)

Role-play activity to analyse a simulation on terrorist groups formation

THE SIMULATION ON TERRORIST GROUPS FORMATION

- Simulation developed within the Horizon2020 "PROTON" project

- A group of physicists was commissioned to model the formation of terrorist groups in European cities and possible policy interventions.

- Agent-based model: individuals interact according to their routines, sharing their opinions on topics like institutional trust and subjective deprivation

- From the agents' dynamics emerges a process of radicalization and recruitment

THE ROLE-PLAY ACTIVITY

- 8 groups of 6 students each

- One student for each group is the master and acted the role of a mayor, the others were members of the city council

- The group was requested to negotiate a decision for an intervention to contrast the formation and increase of the terrorist group

- Elements of the simulation were progressively unveiled (data, graphs, scenarios of intervention, elements of the model)

Research question

Which forms of reasoning do students put into play when discussing a complex societal problem through a simulation? In particular, which forms of reasoning are triggered by different elements of the simulation (data, graph, actions and scenarios, model)?

STUDENTS' FORMS OF REASONING

| Construction of the context	
(recent events)	I wanted to say that lately a wave of vandalism has occurred in the city
(places)	If we think about the hypothesis of the agglomeration in the peripheral area, I can still let you know that there are several abandoned buildings that were left, let's say, by companies that have closed
(stakeholders)	There are still families who do not have equal opportunities and who are not yet well integrated, do not yet have a job
(changes)	In the last period the area has been repopulated due to the immigration of a group of people… a repopulation of the neighbourhood occurred
Thinking about solutions	
We have to start integrating these people, starting from small things. By proposing cultural initiatives, giving at least basic social assistance, or in any case also integrating children in schools	
Thinking about causes	
(root causes)	Apparently, there was an external input, or something linked to what my colleagues said, some migration phenomena or some discontent, which led to the formation of the group
(mechanism of interaction)	In my opinion there must have been a triggering event that has caused discontent between several people… and one person, maybe two people had the idea of acting, doing something… then others started to gather around them
(guilty parties)	Regarding the formation of this group, of this aggregate of people, do you know if they have entered the city in recent months or is it a group of people who have lived in the city for years?
(problematic places)	We could find an origin not in a square in the city centre but in an area where there are strong migratory flows or strong agglomerations

ELEMENTS OF THE SIMULATION AND FORMS OF REASONING
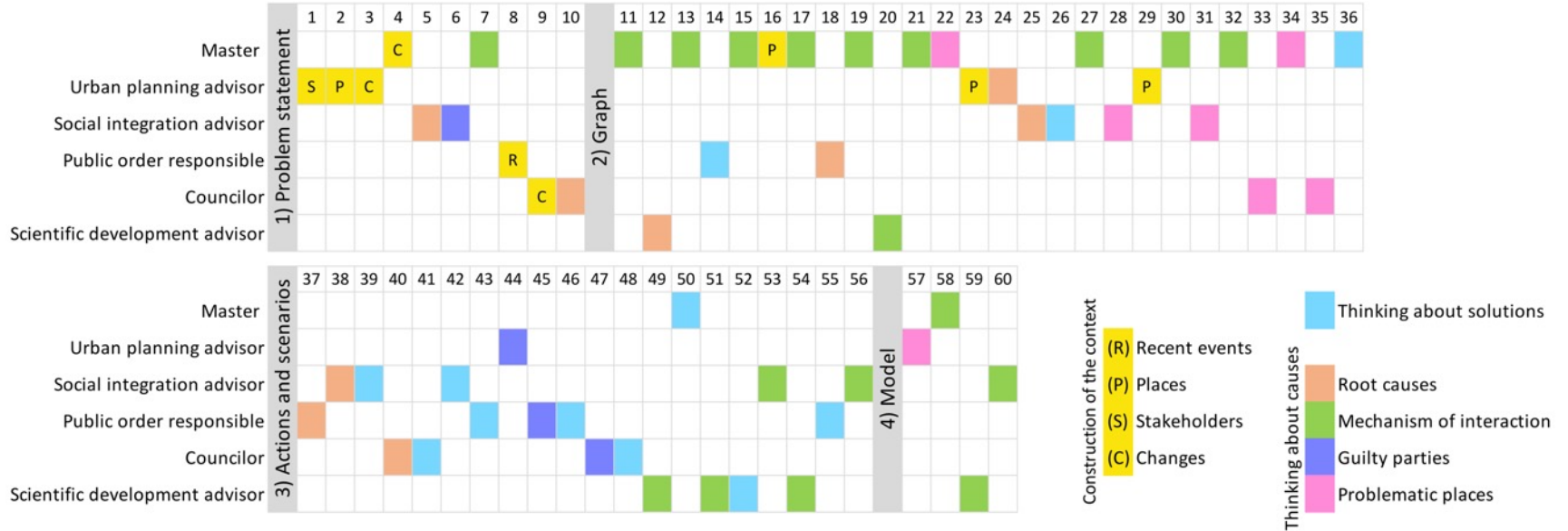
ELEMENTS OF THE SIMULATION AND FORMS OF REASONING

Introduction in the discussion of the model of opinion dynamics

CONCLUSIONS

- Students display different forms of reasoning, activated by the different knowledge elements embedded in a simulation

- These reasonings allowed to compare intervention scenarios and negotiate informed decisions

- The potential of simulations lies also in their multifaceted character that embed a diversity of knowledge forms; each of them has its own specificities and can trigger different reasonings on the same simulated problem

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