

IDENTITIES

Enlightening
Interdisciplinarity
in STEM for Teaching

SESSION 2

Module on the evolution of the COVID

Interdisciplinarity at the service of Society

Submodule 2

Role of **student experiencing interdisciplinarity**
Let **participants experience an adaptation of a teaching proposal** (in her own shoes) to make interdisciplinarity emerge, distributed into some particular “lines of inquiry” about the Covid evolution

SESSION 1

Submodule 1

Role of **interdisciplinary explorer**
Make explicit with participants the **initial question(s) related to interdisciplinarity on the selected topic** and first look for answers
Science and interdisciplinarity
← → Society ← → Secondary school

SESSION 3

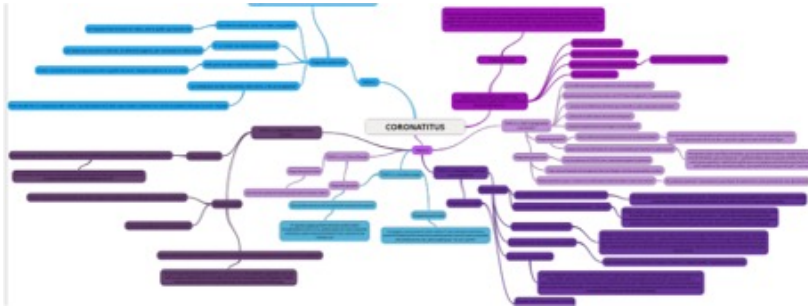
Submodule 3

Role of **interdisciplinary analyst**
Collective analyse the teaching experience that comes to be experienced
Epistemological analysis of the disciplinary (un)balances and of interdisciplinarity
Linguistic analysis of interdisciplinarity

Submodule 4

Role of **interdisciplinary designers and teacher**
Immersion in **Secondary school practices** related to the activities developed previously
→ Ecological analysis for interdisciplinarity

SESSION 3



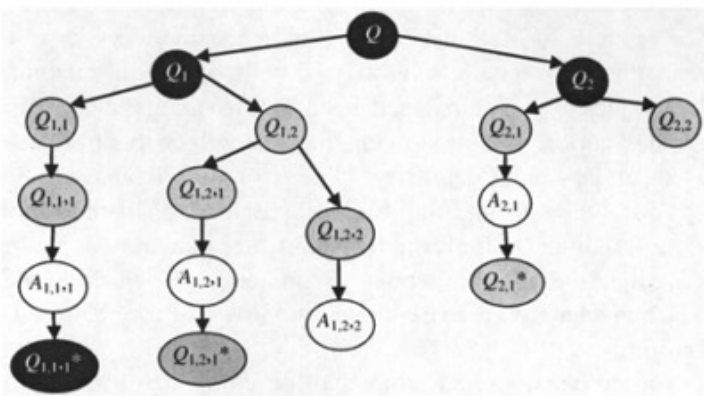
Questions-answers map

as tool for the
epistemological analysis of
the activity

Submodule 3. Role of interdisciplinary analyst

- Construction in group of the **questions and answers map** for each line of inquiry, starting from given initial questions:
 - Make explicit the questions you were addressing and the link or relation they established among them
 - make explicit the links among all!

Big group sharing and comments to highlight links among the lines.



Winsløw, Matheron, & Mercier (2013). Study and research courses as an epistemological model for didactics. *Educational Studies in Mathematics*, 83, 267–284.

Q: You are given data showing the development of the size of a population of geese on an island, over a period of time. How can we predict its size at a later time?

Q1: ... discrete models, population size x_n given at times $t = nt_0$ where t_0 is fixed ("generation")

Q1,1: ... assuming that a generation depends only on the previous one : $x_{n+1} = f(x_n)$

Q1,1,1: ... assuming constant relative growth: $x_{n+1} = (1+k)x_n$

A1,1,1: Malthusian model, $x_n = (1+k)^n x_0$

Q1,1,1*: The answer **A1,1,1** is unrealistic as growth is unlimited. How can assumptions be modified – what about other models of type $x_{n+1} = f(x_n)$, where f is a C^1 -function?

Q1,2: ... assuming that the n th generation x_n depends on the d previous ones : $X_{n+1} = f(X_n)$, where

$$X_n = (x_{nd}, x_{nd+1}, \dots, x_{nd+d-1}) \in \mathbb{R}^d$$

Q1,2,1: ... assuming linear model $X_{n+1} = AX_n$ where A is a $d \times d$ -matrix

A1,2,1: After n periods: $X_n = A^n X_0$

Q1,2,1*: How does A^n behave? Stability as $n \rightarrow \infty$?

Q1,2,2: ... assuming affine model $X_{n+1} = AX_n + b$ where A is a $d \times d$ -matrix and $b \in \mathbb{R}^d$, what happens?

A1,2,2: After n periods: $X_n = A^n X_0 + \sum_{k=0}^{n-1} A^k b$ (stable as $n \rightarrow \infty$ under some conditions)

Q2: ... continuous modeling the population size as a continuous function: $x(t)$ where t is time

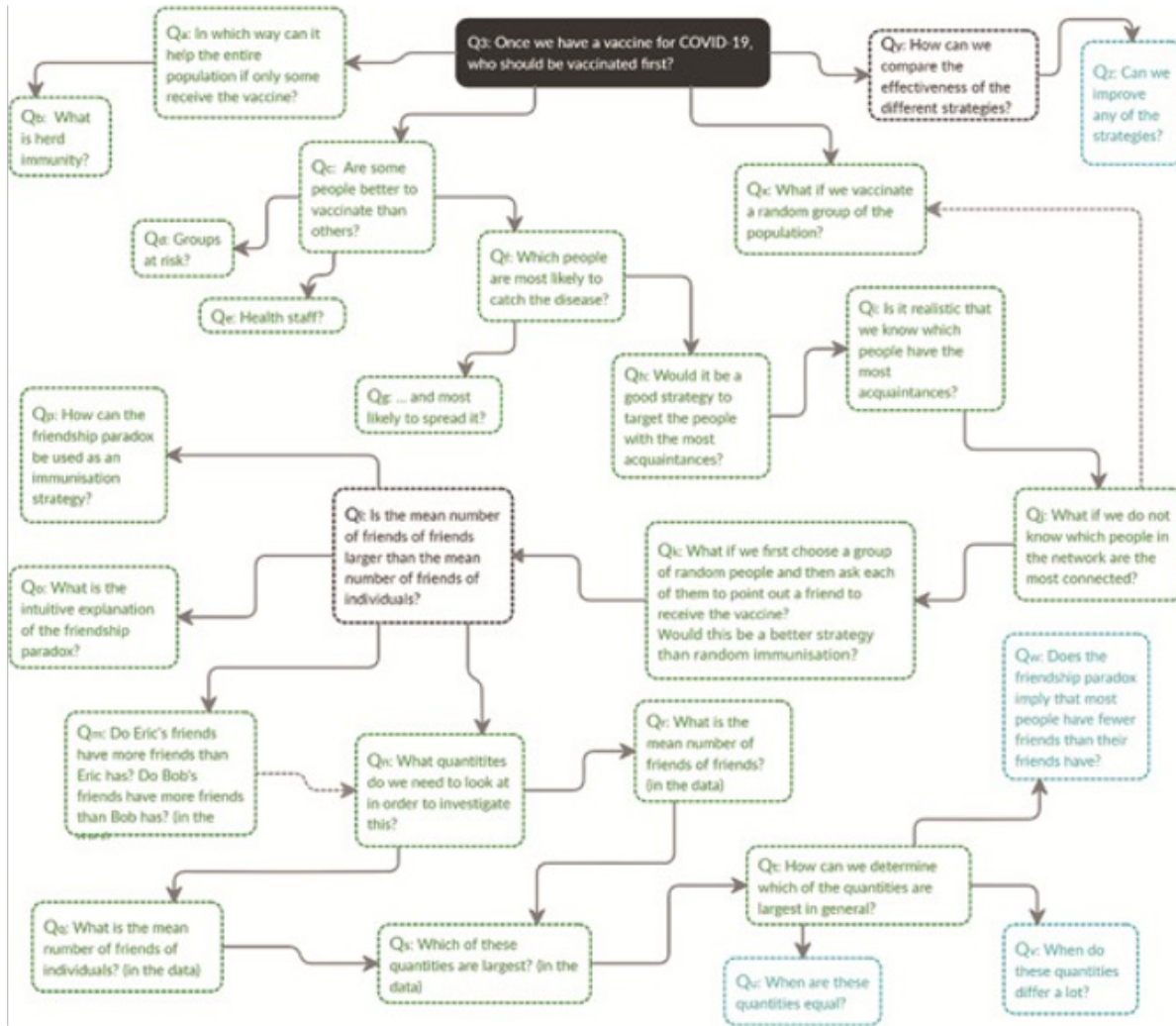
Q2,1: assuming constant relative growth: $x'(t) = kx(t)$

A2,1: Exponential growth, $x(t) = be^{at}$ (in particular, unlimited growth)

Q2,1*: ... How about relative growth with upper bound: $x' = kx(K - x)$ (logistic model)

Q2,2: How about other continuous models, like $x' = f(x, t)$, or higher order ODE models?

Fig. 2 Outline of SRC designed and experimented by Barquero et al. (2007)



Jensen, M., & Winsløw, C. (2021). Questioning corona-a study and research path. *Teaching Mathematics and its Applications: An International Journal of the IMA*, 40(2), 154–165. <https://doi.org/sire.ub.edu/10.1093/teamat/hrab003>

Map before the activity...

[where we had provided a very first sketch of the questions-answers map we listen from you in your working group and in the presentations]

**Interdisciplinarity
at the service of society:
Interpreting the evolution of COVID-19**

IDENTITIES

Enlightening
Interdisciplinarity
in STEM for Teaching

Q0.1: How have the S-T-E-M disciplines interacted to investigate the evolution of COVID-19? What answers have been given and how have their advances spread to society?

Q0.2: What role does it play and how can we analyze interdisciplinarity when addressing complex issues related to the evolution of COVID-19?

Q0.3: How can this interdisciplinary practice transposed and diffused to secondary schools?

1st line of
interdisciplinary
inquiry

Q0_L1: What can data reveal about
COVID-19's evolution?

Q1: What data do we select to understand better the
evolution of healthy, infected, death ... people along
the pandemic?

Q1.1: How pandemic and the number of
infected, death, recovered... people have
varied in the different countries?

Q1.2: What data might we select if we want
to compare the effects of vaccination on
the evolution of death people?

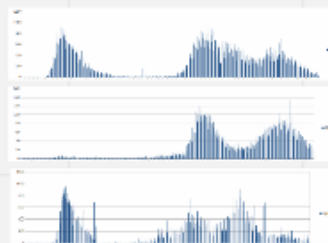
Q2: Is data well reported in all the
countries? Is it reported in the same
way?

Q2.1: Is there other resources (media) where
we could validate the data we are collecting?

Q1.1.1: What information we can
extract when plotting the evolution of
death people in the different countries?

HOLA

Type something



2nd line of
interdisciplinary
inquiry

Q0_L2: What is the role of models and
modelling in investigating the
evolution of COVID-19?

QL1_L2: What do we mean by the
modelling data?

QL1_L2: What do we mean by the word
analysing and the word processing data ?

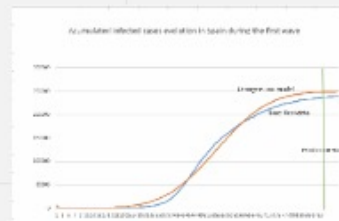
Q1: What is a model?



Q2: Which can be the goals of modelling
some data? That is, what do we intend to
study when modelling the actual data on
the evolution of COVID-19?

Q1.1: What is a "good" model? What would
be a "good" model for understanding the
evolution of COVID-19?

Q1.1.1: Why this model, based
on an error function, can be
considered a "good" model
fitting the given data?





Q0.L3: How can computational simulations support decision-making processes about future actions in the context of the pandemic (from political, economic, medical, etc. perspectives)? What is their validity and function?

QL3.1: How can the computational simulations support decision-making processes about future actions in the context of COVID-19?

QL3.2: Where is the limit we can work with the complexity of the simulations to adapt to the reality?

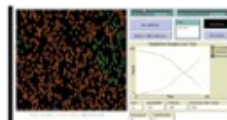
As we introduce more variables, the simulator becomes harder

Q1.1: What are the main parameters of the different agents (humans) we can use to predict the pandemic evolution?

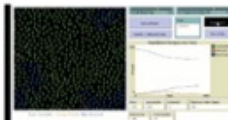
How this parameters are coded in the simulators?

How does the simulations change when the parameters are changed?

Low social distancing, but 100% people practicing it



High social distancing, but 70% people practicing it



Moderate social distancing, 100% practicing it



In 42 days 122 deaths



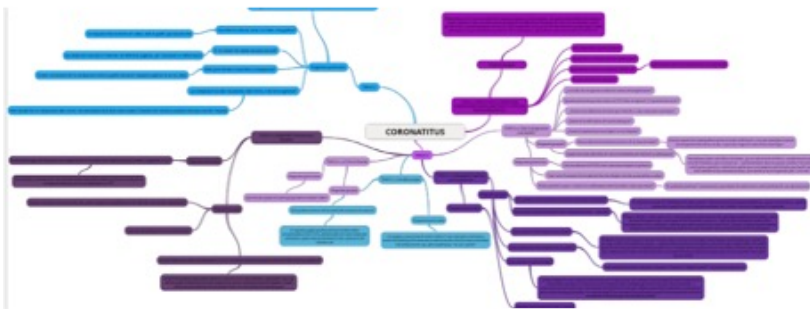
Slow
in 166 days 31 deaths



29 days, 0 deaths

Map after the activity...

Let's look at them!



Question
answers map
+
Advanced
guide



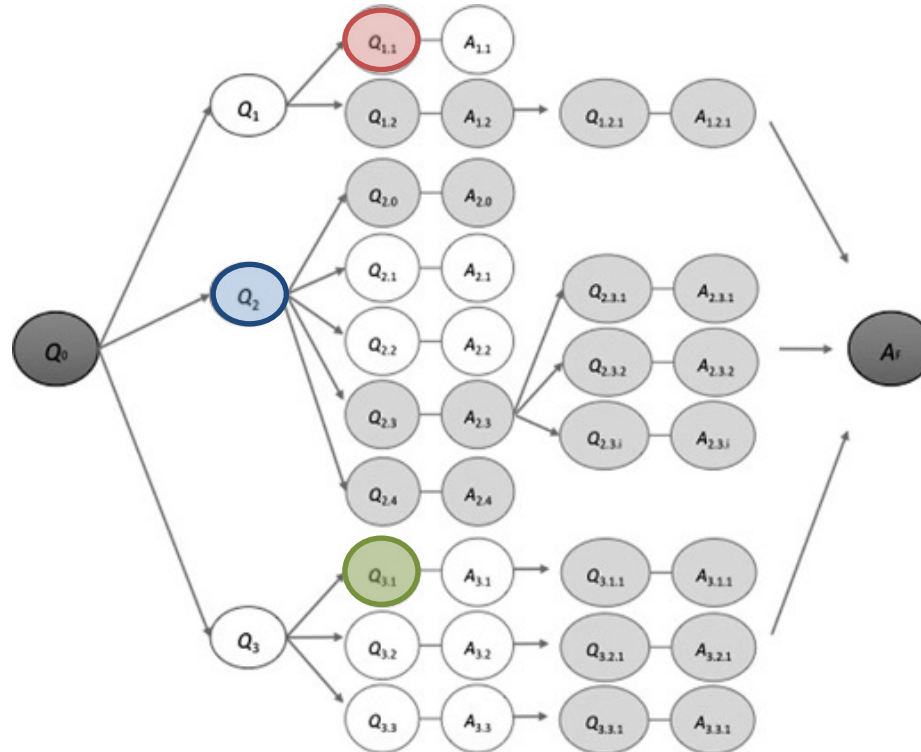
- Based on the different analyses you developed throughout the module, you will now be asked to recognise more explicitly the role of the disciplines and the role of interdisciplinarity that has emerged. The questions that will guide your analysis are structured according to the four boundary crossing mechanisms you have encountered in the module. In answering, we recommend that you focus on the specific activities you have experienced in the module as far as:
- 1. Identification:** What disciplines can you identify in the activities you have experienced? What has been the role of each? What tools and knowledge have these disciplines provided regarding the general topic of the module?
 - 2. Coordination:** How would you describe the relationship that has been established between the disciplines involved in the module?
 - a) Are there any problems, issues or questions in which the kind of knowledge coming from one particular discipline has been sufficient to advance? Supply your examples.
 - b) On the contrary, which problems, issues or questions have required knowledge coming from different disciplines and their interaction? What were the points that opened up a need for disciplinary interaction? Supply some examples.
 - 3. Regarding the issues that have required the interaction of disciplines:**
 - a) Reflection: What changes can be observed between the role of each discipline in this interdisciplinary context and the role traditionally assigned to them in schools or universities?
 - b) Characterisation: What new knowledge and new interdisciplinary practices have been achieved thanks to the interaction between disciplines on this issue? Select an example or situation that you have experienced in the module that will help you explain this mechanism.
 - 4. In the light of the analysis you have done in the questions before, what are in your opinion the boundary objects that can be identified in the module?**

Submodule 3. Role of interdisciplinary analyst

Presentation of the **2nd guide for ID analysis**

Work in mixed groups [3 groups of 4 students each, at least one student for each line] on the 2nd guide for ID analysis.

Big group sharing and debate on the questions of the guide



And please refer to
the particular parts
of the questions
and answers
maps, where you
have a lot of
information!

IDENTITIES

Enlightening
Interdisciplinarity
in STEM for Teaching

SESSION 2

Module on the evolution of the COVID

Interdisciplinarity at the service of Society

Submodule 2

Role of **student experiencing interdisciplinarity**
Let **participants experience an adaptation of a teaching proposal** (in her own shoes) to make interdisciplinarity emerge, distributed into some particular “lines of inquiry” about the Covid evolution

SESSION 1

Submodule 1

Role of **interdisciplinary explorer**
Make explicit with participants the **initial question(s) related to interdisciplinarity on the selected topic** and first look for answers
Science and interdisciplinarity
← → Society ← → Secondary school

SESSION 3

Submodule 3

Role of **interdisciplinary analyst**
Collective analyse the teaching experience that comes to be experienced
Epistemological analysis of the disciplinary (un)balances and of interdisciplinarity
Linguistic analysis of interdisciplinarity

Submodule 4

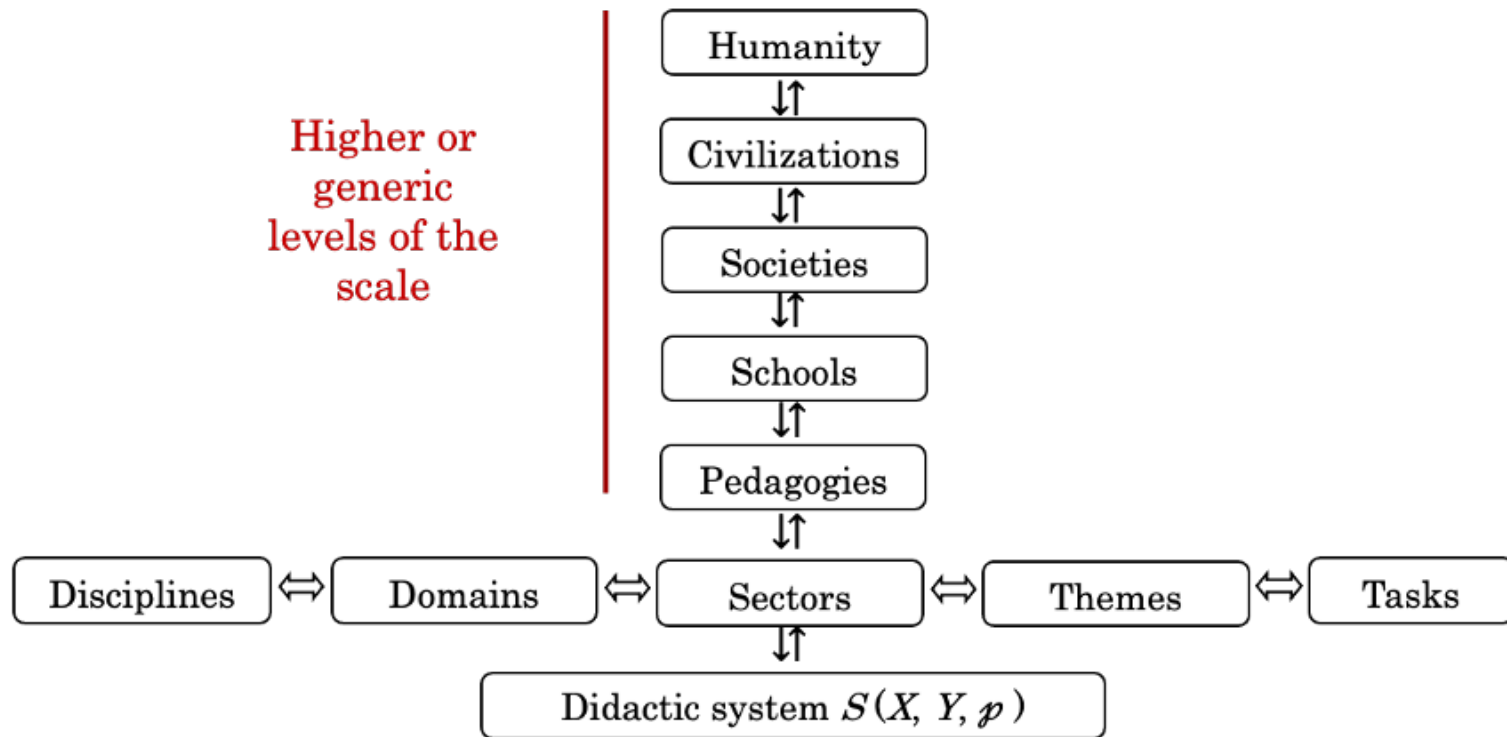
Role of **interdisciplinary designers and teacher**
Immersion in **Secondary school practices** related to the activities developed previously
→ **Ecological analysis for interdisciplinarity**

SESSION 3

Let's now think as we were (or we are) **designers** of similar activities and **teachers** implementing these activities....

- Which questions, through which activities, could be transposed into Secondary school education? If possible, specify or exemplify which ones.
- Which opportunities or conditions would be offered that facilitates this transposition towards Secondary school?
- Which difficulties, limitations or constraints would hinder or could prevent to implement the inquiry into this open questions into Secondary schools?

Scale of levels of didactic co-determinacy (Chevallard, 2002)



Lower levels of the scale, specifics to the discipline

IDENTITY

Teacher knowledge,
traditions of teacher
profession → TEACHING
AS A SCIENCE

Module on the evolution of the COVID

Submodule 4: Thinking as designer and teacher

What is in the
common
ground for
them? What is it
require to be
done
beforehand?
You can create
a difficult
position to be.

Need of new curricula with
collaboration among
researchers and teachers

New means of
communication

Official role of some disciplines,
such as Computer Science. An
**opportunity to rethink
curricula and how disciplines
are defined in the schools.**

Humanity



Civilizations



Societies



Schools



Pedagogies

Get closer what it is around us, bring to **school**
real and legitimated questions with social
relevance

How to think critically analyse what is
disseminated to society?

Need of collaboration among teachers of
different disciplines, the ones that have “more
tradition” with the ones that in the school usually
remains independent, such as “maths”,
“science” with “language”

Disciplines



Domains



Sectors



Themes



Tasks

Reduce the tools to the ones that are closer or more pertinent for Secondary school education
or reduce the questions (for instance: exponential growth)