Socially Acute Questions and Socio-Scientific Issues: Methodological aspects to analyse discussions, perception of risks and reasoning

Laurence SIMONNEAUX

SAQ/SSI

- At a time when numerous crises are undermining the status of (techno)science, the teaching of **Questions Socialement Vives (Socially Acute Questions** in English- SAQs)/ **Socio-Scientific Issues** (SSIs) has a part to play in the risk society.

- SAQs/SSIs are open-ended questions that involve ill-structured problems, they are complex and raise uncertainties.

- These questions are at the heart of the problem of teaching / learning in an uncertain world, in connection with current events, with the development of techno-science, with environmental and health crises ...

SAQ/SSI

- These questions situate social and scientific **controversy**, **complexity**, the building of **expertise**, the assessment of **evidence**, **uncertainty** and **risk** at the very heart of the teaching-learning process.

- They are considered in the perspective of situated learning.

- **Context** is of importance :

  - a real-world context (global or local) perceived through individuals' **identities** (linked to gender, culture, political position, profession…)

SAQ/SSI

- One of the goals of science education is to help students develop their understanding of how society and science are mutually dependent.

- The notion of SSI has been introduced as a way of describing social dilemmas impinging on scientific fields (Gayford, 2002; Kolsto, 2001 a; Sadler, 2004; Sadler & Zeidler, 2004; Sadler, Chambers & Zeidler, 2004; Zeidler, Walker, Ackett & Simmons, 2002…).

- These issues are very often controversial and they have implications in one or more of the following fields: biology, sociology, ethics, politics, economics and/or the environment.

SAQ

• Legardez and Simonneaux (2006) have defined the term “Questions Socialement Vives” (Socially Acute Questions).

- SAQs are the object of controversies between specialists from different disciplinary fields and/or between experts from associated professional fields.
- SAQs challenge social practices, reflect social representations and value systems that society believes it is important to discuss.
- They are controversial in society. Consequently they have the potential for debate in classrooms.

• They are ‘acute’ (‘vives’ in French) in three spheres:

- **in society and in media,**
- **in the research and professional fields,**
- **in the classroom.**

SAQ

• Teaching SAQs integrate learning of content knowledge both in science AND in the humanities, and learning of the construction of science (construction of knowledge ABOUT humanities AND science).
They promote an **interdisciplinary** approach.

• In the French context, teaching SAQs has a wider span, it integrates :
- Humanities Socially Acute Questions,
- Scientific Socially Acute Questions which are the one we are interested in here.

• In science curricula and in the guiding principles of “education for” programmes.

• Science education might be, and should be, framed if it is to engage students in a science that is relevant and powerful for them as future citizens (Tytler, 2012).

SAQ anchorage

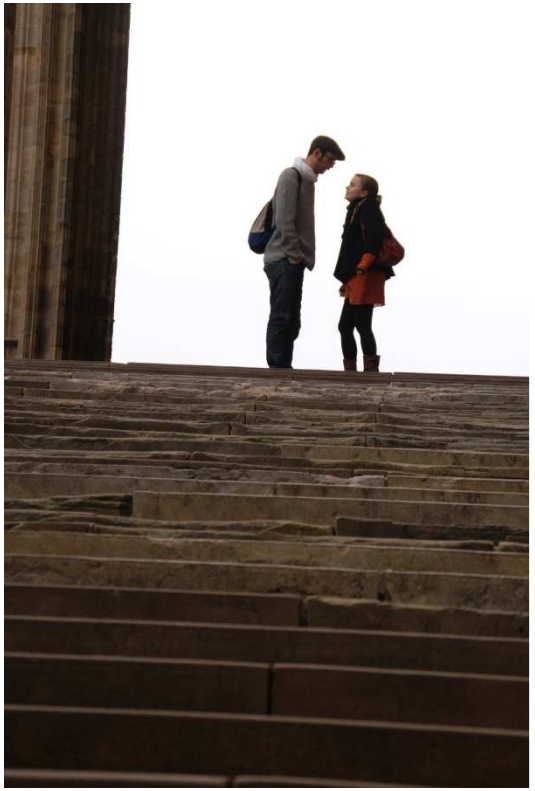
•The SAQ approach emphasizes the degree of “acuteness” of the question in the world of research and / or society.

• Teaching SAQs contributes to scientific literacy with risk analysis, to political literacy with analysis of patterns of political and economic governance, decision making and action being central.

• SAQs are symbolic of **risk society** Beck (1986, 2001)

• Using Beck’s analysis, in our late-modern society, scientific rationality would not be sufficient to justify any technoscience and would need to be accompanied by reflexive criticism of its impact.
Modernization becomes reflexive (Beck)
Reflexivity : awareness + action

SAQ anchorage



- SAQs lies within the field of **Post Normal Science (PNS)** as defined by Funtowitcz & Ravetz (1993) as a science with strong links to human needs, thereby leading to large uncertainties, major issues, values, and requiring urgent decisions.

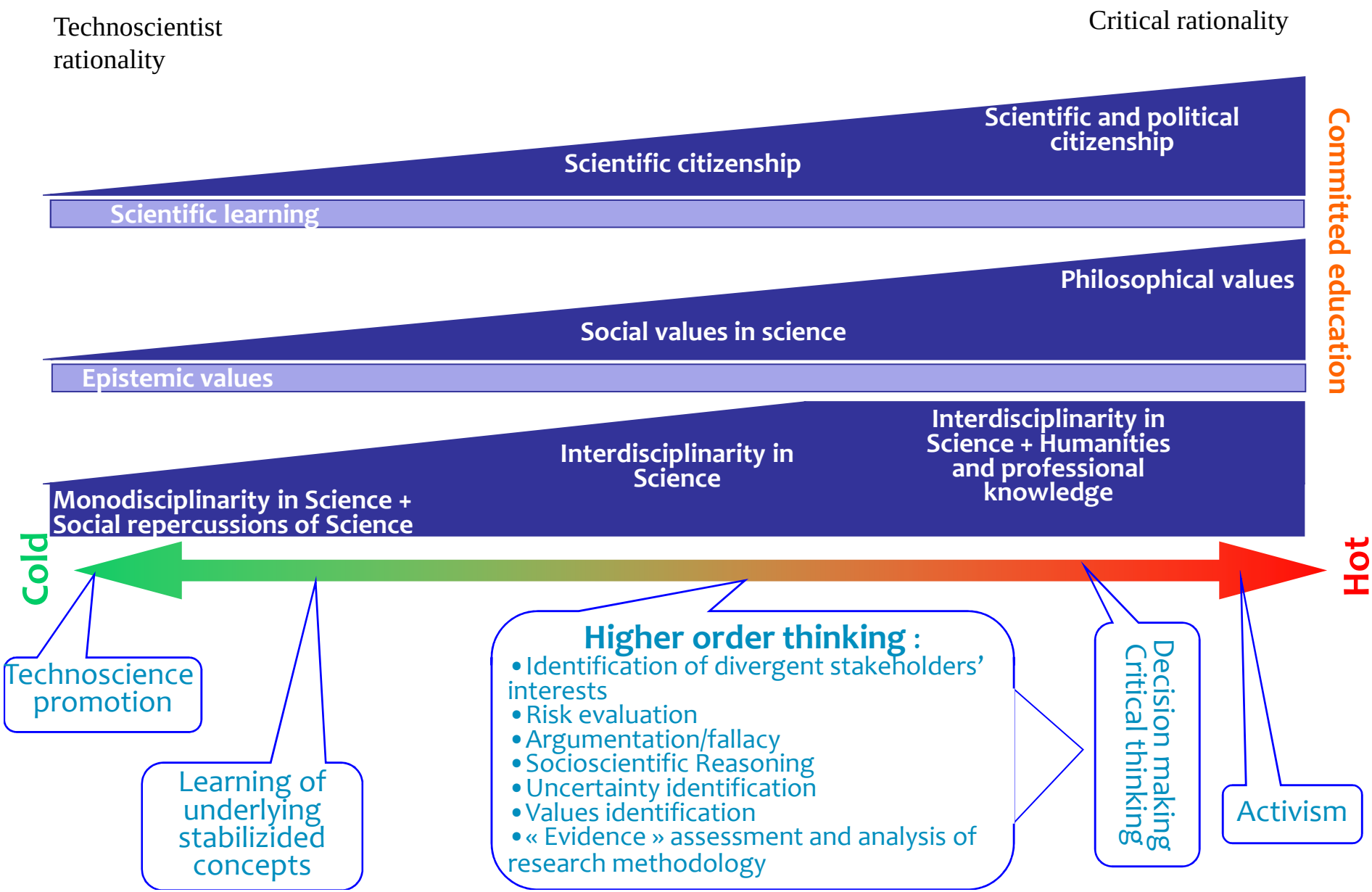
- According to Ravetz (1997), the question "what if? " justifies strong consideration "to extended facts ", that is to say, data from sources outside the orthodox research.

- These authors emphasize that the decision process on the PNS should include open dialogue with everyone concerned. They introduce the concept of "extended peer community".

- It is important to train students to participate within the "**peer extended community".**

- The teaching of SAQs raises the question of the **interdependence of the cognitive, the affective, and the axiological** in education and training.

Diversity of stakes and pedagogy



Psycho-social approach

- Given the nature of SAQs, it is necessary to analyze the psycho-sociological factors that determine the positions, reasonings and behavior of the actors. Many studies have been made in this direction (In particular Sadler & Zeidler). Positions are influenced by:
  - Value systems
  - Cultural and socio-professionnal identities
  - Perceptions of norms
  - Cultural bias in particular concerning risks' perceptions (Douglas)
  - Future projections
  - Ethical postures

- Need to analyse the impact of emotional points of view

- Analysis of argumentation and reasoning

Nanotech debate

"Are nanotechnologies capable of human enhancement and is it desirable?"
Simonneaux *et al*. 2013, *IJSE*, 35:14, 2376-2406

- **macrostructure of the debate.**

- **In order to reflect the interactive nature of the debate, we chose to use categorizations developed by Mercer (1995) and supplemented by Mork (2005) from an analysis of linguistic interactions between students.**

Mercer distinguished the following types of discourse: disputational, cumulative and exploratory talks.
Mork added a category: the reasoned disputational talk.

Mercer defined the following three types of discourse:
Disputational ***talk, where characteristic discourse features are short exchanges consisting of claims and challenges or counterclaims. The relationship is competitive, differences of opinion are stressed rather than resolved, and the general orientation is defensive.***

Cumulative ***talk, where characteristic features are repetitions, confirmations and elaborations. Ideas and information are shared, and joint decisions may be reached, but there is little in the way of challenge, or constructive conflict, in the process of constructing knowledge.***

Exploratory ***talk, during which speakers engage in critical but constructive discussion about each other's ideas; when challenges are made, they are backed up with argument and alternative viewpoints are suggested. Compared with the two other types, knowledge is made more publicly accountable, and reasoning is more visible in the talk.***
And Mork's additional category
Reasoned disputational ***talk, here, students oppose but they provide justifications.***

Mercer's framework enabled us to pinpoint the episodes where the students were discussing the risks associated with nanotechnologies.
In these episodes we tried to identify the rationality and risk perceptions of the students using the theoretical frameworks of Beck and Douglas.

The debate identified two differing groups. Each group can be characterized not only by their perception of nanotechnology, but more broadly by their perception of the techno-scientific progress. They called themselves pessimistic or optimistic.
Within each group, they developed cumulative and exploratory talk.
Between the two groups, the discussion took the form of a reasoned disputational talk.

P : *But that, it's not just… nanos just nanotechnologies, it's all of technology in general, and we can't say now that research should be inhibited because it could be abused, (…) we have found that it hum…can be put to really good use, I'm* ***optimistic****.*

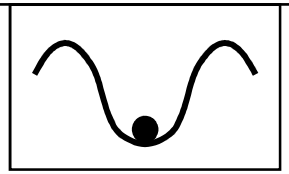
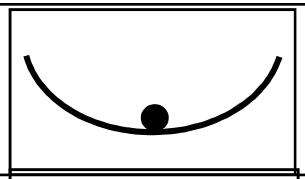
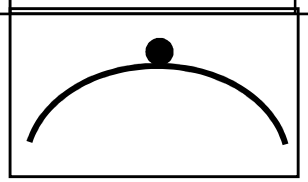
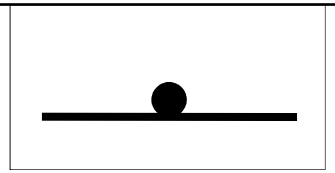
P's viewpoints were taken up in a cumulative way by M, O, F and . P
C, A and D admit to being pessimists but, they think that individual interests in the technosciences takes precedence over the collective interest.

C : *I agree with A, nanotechnologies, (…), as Dominique says, we live in a world where everyone tries to make a profit, and uh nobody would gain anything from improving the whole of humanity…that's a very* ***pessimistic*** *thing to say but nobody would benefit from making everyone equal.*

A : *I go along with Claire, I'd even like to add, it's very* ***pessimistic*** *but, even if someone wanted to do that, well there would be a lot of people ready to prevent him just because it's in their own interest (to keep the power for themselves).*

D : *To get back to the terms of using it well or not , (…) for instance, the people with power in this world, and after all, we can't reasonably ask a, a government, which is precisely in power to, to restrict it's application because even in the worst case of abuse there is always profit to be made and in the end it's a bit utopian to, to say to yourself, yes nice governments, uh shouldn't use nanotechnologies in weapons for example,. But unfortunately it's….*
Unfortunately, there's always someone, there are always people who reap the benefit even if, even if these people are perfectly aware that uh…that it's something harmful but uh…there's always an advantage to be had everywhere (…) I don't think we live in a reasonable enough world. Well, that's maybe ***pessimistic****, but*

The cultural theory of risk perception Douglas

Types	Perception of science	Perception of Nature (robustness)	Perception of risk
Hierarchists	Respect for "official" scientific knowledge		Risk averse, but State and experts will find solutions
Individualists	Respect for innovative researchers		Risk friendly
Egalitarians	Distrust towards "official" knowledge		Risk averse
Fatalists	Ignorance, indifference for knowledge and distrust		Fate to be managed

This research shows that these students spontaneously combined their views of science with their perceptions of risk.

Optimists and pessimists fall into two types according to Douglas: individualistic and egalitarian.

Optimists believe that (techno)science brings progress. They do not dwell on the risks, but focus on the economic and strategic interests. They are close to the individualistic type.

"*In ‘45, we discovered the bomb and everyone said it was horrible, and yet thanks to this, today we have the nuclear defence and there are no more wars, ..* ***wars in the past with millions, with millions of dead, we have learned to find ... uh ... great applications.*** *I am optimistic.* "

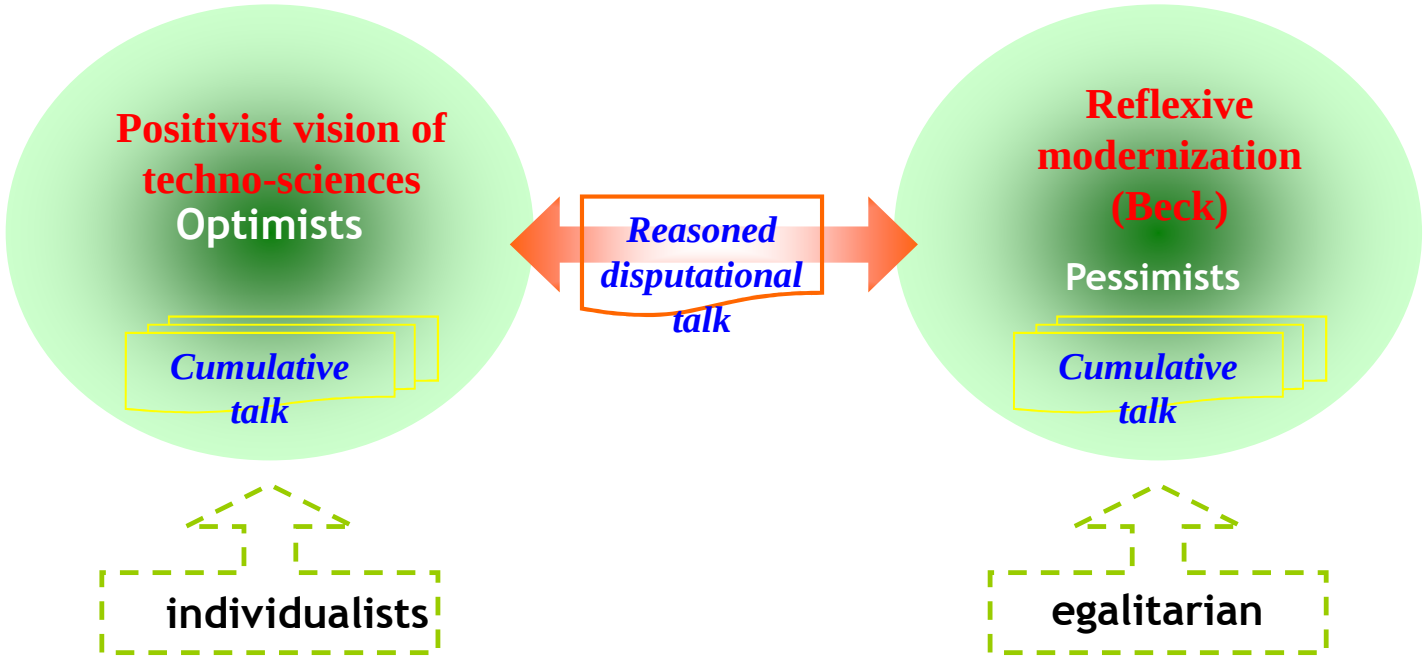
"*We must also bear in mind that in the West, research makes countries* ***front-runners****. So without research, it’s finished. It’s as simple as that. What gives you a ... ... a* ***breakthrough*** *on the Indians, Chinese, …700 million inhabitants: Europe, 750 million people, while the Chinese alone, one billion - and a half. So if we… if we don’t do research, it’s finished. Simple*. "

The pessimistic types demonstrated the characteristics of Beck's analysis. They are "egalitarian" and they are risk averse. In their contributions we found the perception of nature as fragile, and any imbalance as being possibly irreversible. They address public health, but condemn the role of technological advances.

"*I suppose we must also remember that scientific discoveries* ***are not necessarily beneficial*** *(…) well…maybe if we wait to see where a discovery leads us, afterwards* ***it may be too late to set a limit and the damage may already have been done****. Well, uh for example uh, nanotechnology can be used to screen for cancer…? But, if we didn't use all the technologies we use today, there would be much less cancer anyway. So, perhaps, is it really worth using these technologies if these…****afterwards cause even worse problems*** *than what they…they have helped to solve?"*

*" What we are going to develop is perhaps going to have more of…****more harmful effects*** *in the end than, than…the progress it will bring and so uh, can't we just be satisfied with what we've got?"*

" Regarding cancer, and that we have seen it developing, certainly because we live longer, but we also develop it because there are waves everywhere, but in the Southern countries there are no mobiles, no radio antenna, no microwaves, so uh ... I agree that we have made technological advances, anyway, ***these technologies have a lot to do with cancer.****"*


Positivist vision of techno-sciences
Optimists
Cumulative talk
Reasoned disputational talk
Reflexive modernization (Beck)
Pessimists
Cumulative talk
individualists
egalitarian

A Socio-Scientific and Sustainability Reasoning (S^3R) Model

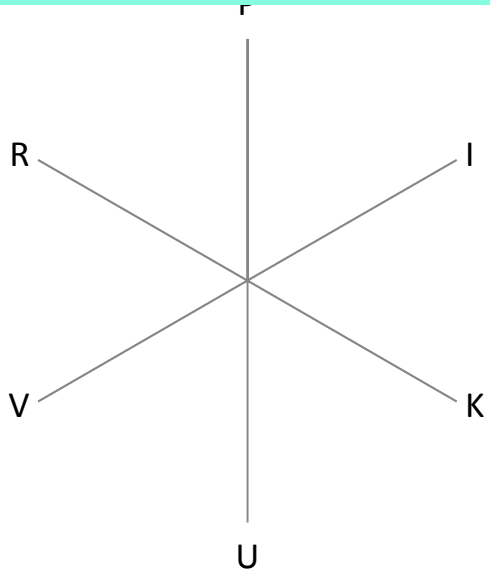
A Socio-Scientific and Sustainability Reasoning (S^3R) Model (Chrysomèle)

O Morin, L Simonneaux, J Simonneaux

Problematisation : Are the disparate aspects (rnvironmental, social, environmental) of the situation tackled from different points perspectives?

Regulations : Are the relationship between private and collective interest considered for a variety of social institution?

Interactions Are the dynamics of eco-socio-systems envisaged over different social, temporal or spatial scales?



Values: Is there an awereness of the values involved in the issue?

Knowledges : How are different Knowledges mobilized?

Uncertainties & risks : Are the conditions of validity of knowledge and the techno-scientific risks grasped?

Franco-Australian Program« Exploring socio-scientific issues through digital technology: the impact of context and culture » green algae, desalination, meet consumption…) Morin, Simonneaux, Simonneaux, Tytler, Barraza

For each dimension, we have defined indicators of four levels of complexity:

Problematisation: Are the disparate aspects (environmental, social, and economical) of the situation tackled from different perspectives? The graduation deals with the awareness of complexity in the construction of the problem.
Interactions: Are the dynamics of eco-socio-systems envisaged over different social, temporal or spatial scales? The graduation deals with the awareness of complexity of interactions within dynamic systems.
Knowledge: How are different knowledges mobilized? The graduation deals with the articulation of academic and other forms of knowledge.
Uncertainties: Are the conditions of validity of knowledge and the techno-scientific risks grasped? The graduation deals with the expression of epistemological doubt and the contextual nature of knowledge claims.
Values: Is there an awareness of the values involved in the issue? The graduation deals with the explication and clarification of value positions.
Governance: Are the relationships between private and collective interests considered by a variety of social institutions (family groups, peer groups, professional groups, associations, public institutions, nations)? The graduation deals with the extent of consideration for regulatory processes that enable citizen participation in balancing interests.

Didactic scenario

Collaborative expertise of ESAQ

on a DWE (forum)

Which action do you advocate as a group ? Why and under which conditions ?

with (or without) face to face debate

Collective wiki

Confrontation of wikis from different groups

Adds & modifications in the first wiki

Corpus of data

Records & history of discussions

History of wikis

History of inter-groups forum

History of second wikis

24 groups 108 students

	IUFM Lyon 1	enfa ECOLE NATIONALE DE FORMATION AGRONOMIQUE TOULOUSE-AUZEVILLE	DEAKIN UNIVERSITY AUSTRALIA
IUFM Lyon 1	1 country 1 discipline SVT 6 groups		2 countries 2 disciplines SVT-SE 8 groups
enfa ECOLE NATIONALE DE FORMATION AGRONOMIQUE TOULOUSE-AUZEVILLE		1 country n disciplines Agro,Eco,ESC 4 groups	2 countries n disciplines Agro,Eco,ESC-SE 6 groups

SE : Science & Environmental Education SVT ; Biology & Geology
Agro : Agronomy Eco : Economy ESC : Socio-cultural Education

Criteria used to characterize the types of action defined by Habermas

Types of action	Rational behavior	Communication aim	Reasoning model
Communicative action	The person orients his actions according to criteria of validity. recognized intersubjectively. The validity claims refer to the objective world (true), to the social world (fair norms) and to the subjective world (sincere subjective experiences)	To reach a shared objective and mutual understanding. Does not accept domination. Research and practice of symmetry.	**The actors aim to coordinate their actions by way of agreement which begins with the negotiation of shared interpretations.**
Normatively-regulated action	The actions are based on the values of the social group (internal and external norms of the group)	To recall and establish the norms	**The actors try to impose a decision legitimated by the norms.**
Dramaturgical action	**The actions are based on an appeal to the other person's feelings**	**To achieve agreement by way of the emotions.**	**The actors use the emotions to achieve agreement**

Habermas's worlds	Objective	Social	Subjective
Claim to	Truth	Rightness	Sincerity
Reference	Science	Society	The person
Language acts	Constative speech acts	Regulative speech acts	Expressive speech acts
Modalizations	Logical	Deontic	Appreciative

Interactional socio-scientific reasoning framework

Orientation of speeches (Mercer, 1995,2002)

Exploratory talks

4 integrative

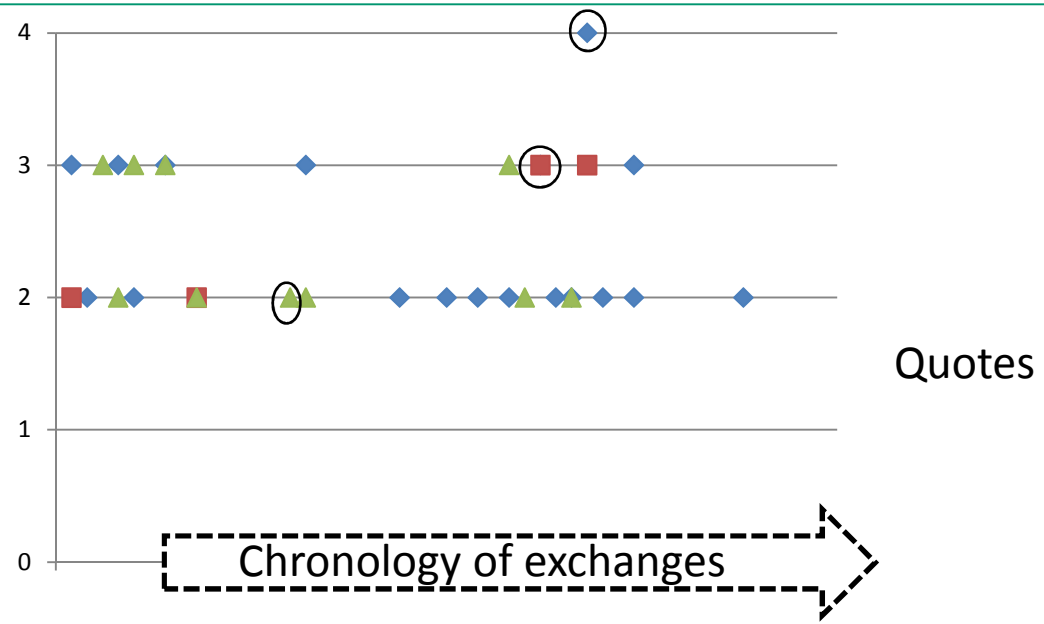
3 distributive

2 Cumulative talk

1 Disputational talk

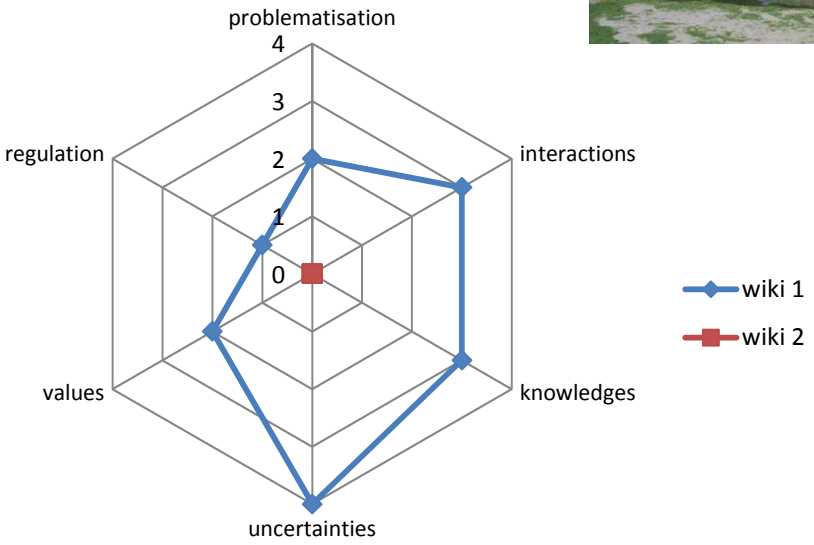
Validity claims of speech (Habermas, 1987):

- **Objective world :** based on empirical efficiency and "scientific truth"
- **Social world** : based on social norms
- **Subjective world** : based on personal experiences



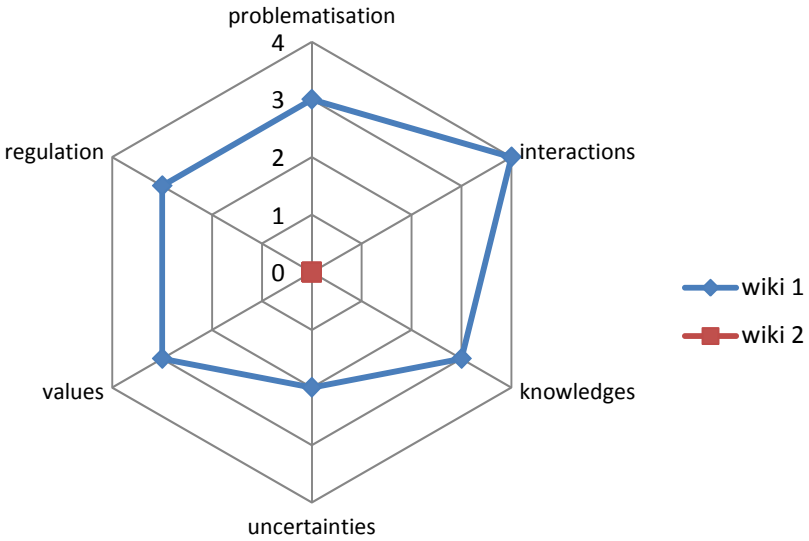
Interactions during the construction of the first wikis

Mono/multidiscipl. Expertises (French groups) :



Green tide : SVT

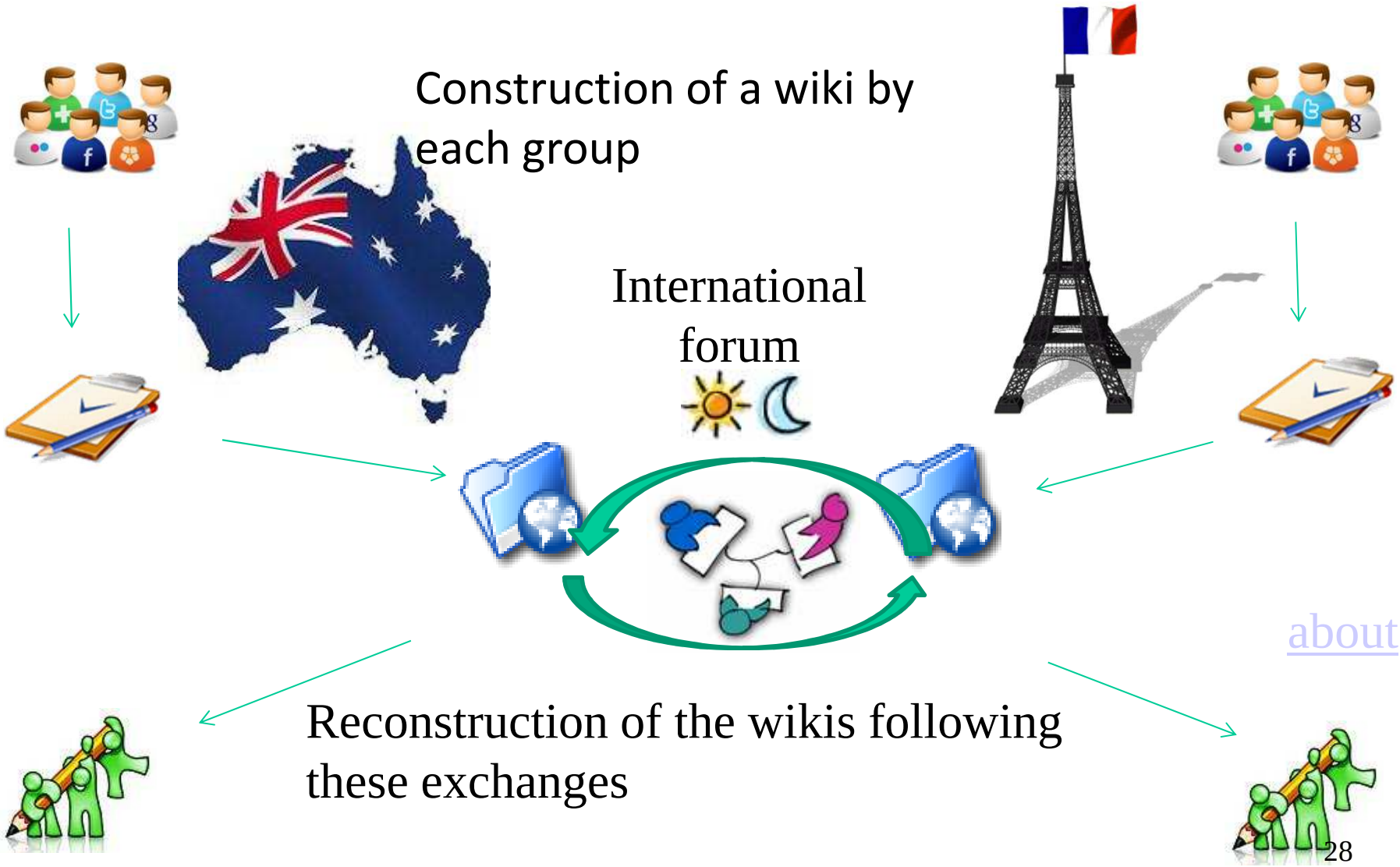
1 country
1 discipline



Green tide : Eco, Agro, ESC

1 country
n disciplines

International interactions

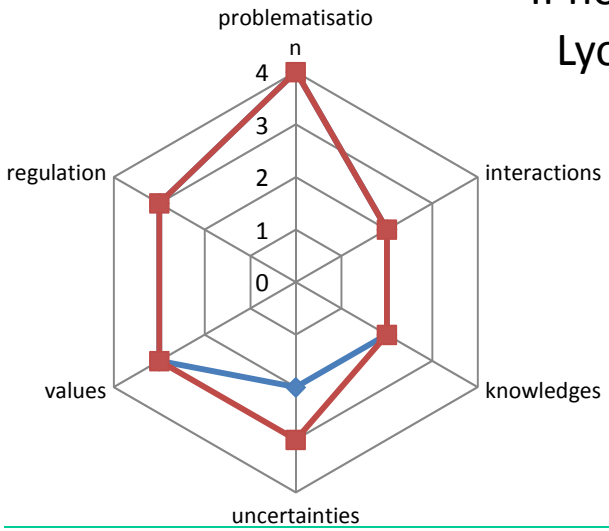


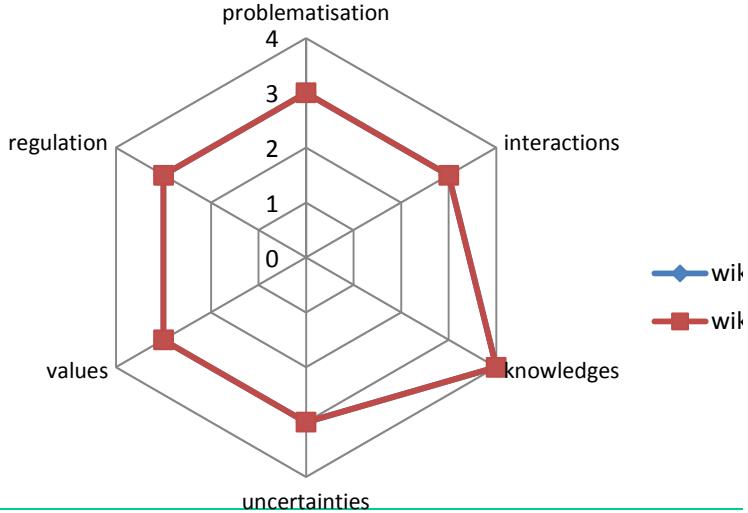
about

International interactions

If no cross-cultural approach

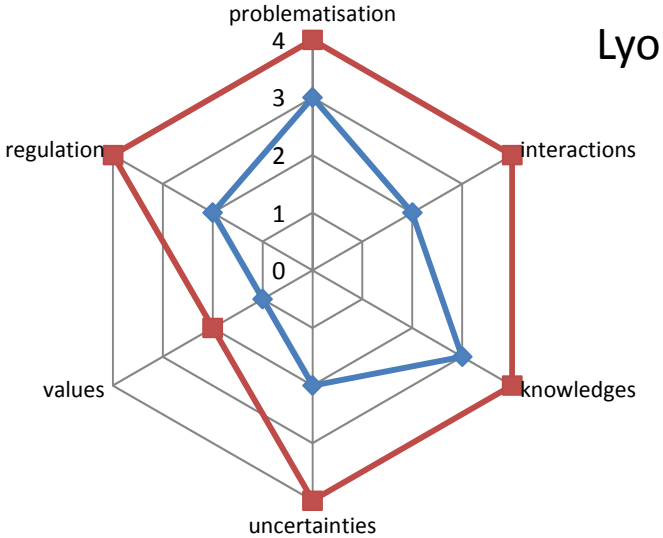
Lyon ⟷ Lyon

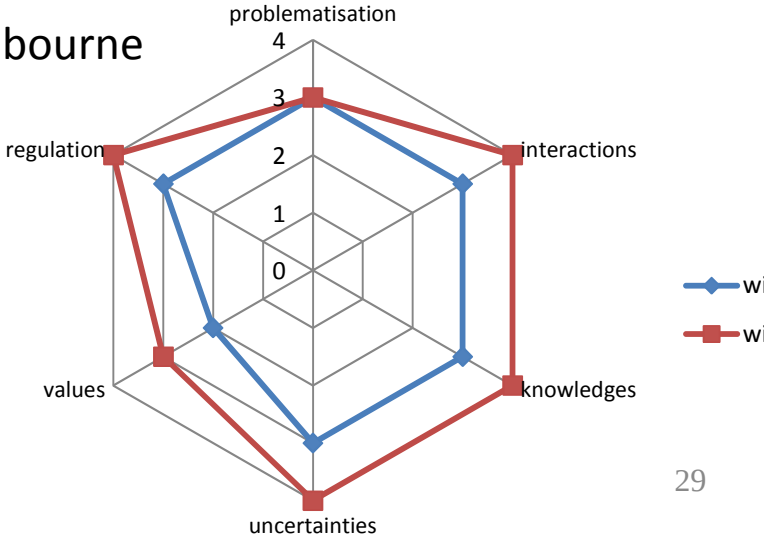




When a cross-cultural approach

Lyon ⟷ Melbourne





	Discursive orientations of group contributions			Justifications des opinions raisonnées		S3R in wikis 1	S3R in wikis 2	Evolution of S 3Rs
	CUMULATIVES	EXPLO DIST	INTEGRATIVES	One world	Mix of worlds			
V5M	0,00	0,00	100,00	15,38	84,62	21	24	3
E4M	0,00	5,56	94,44	33,33	66,67	20	21	1
V4L	6,06	3,03	90,91	42,42	57,58	13	22	9
V5L	5,26	5,26	89,47	31,58	68,42	14	20	6
V4M	25,00	4,17	70,83	54,17	45,83	17	22	5
E4L	25,00	8,33	66,67	41,67	58,33	11	18	7
E5L	50,00	14,29	35,71	92,86	7,14	16	18	2
E5M	53,33	13,33	33,33	80,00	20,00	20	21	1

The S3R are deepened when the groups have different cultures (discipline, country…) and when they develop integrative exploration.

The multidisciplinary approach allows the pooling of distributed knowledge and specific approaches, but requires the construction of a collective formulation of the problem. It is favored by a phase of debate (albeit brief).

S3R are improved when the arguments have a triple claim to validity:
-accuracy (by reference to the objective world)
-fairness (by reference to the social world)
-sincerity (by reference to the subjective world).

Confrontation of groups with different organizing principles creates a socio-epistemological disturbance. Interactions involve then re-negotiation of the definition of the situation by promoting the development of arguments in the three areas of reference.

Thank you for your attention