Science education at crossroads: Socio-scientific issues and education

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Overview

- Background information
- Relevant literature review: historical context
  - Public understanding of science
  - Science and technology communication
- Pedagogical goals and implementation
  - Scientific and technological literacy
  - Humanistic and social scientific consciousness
- Challenges and beyond

Who we are

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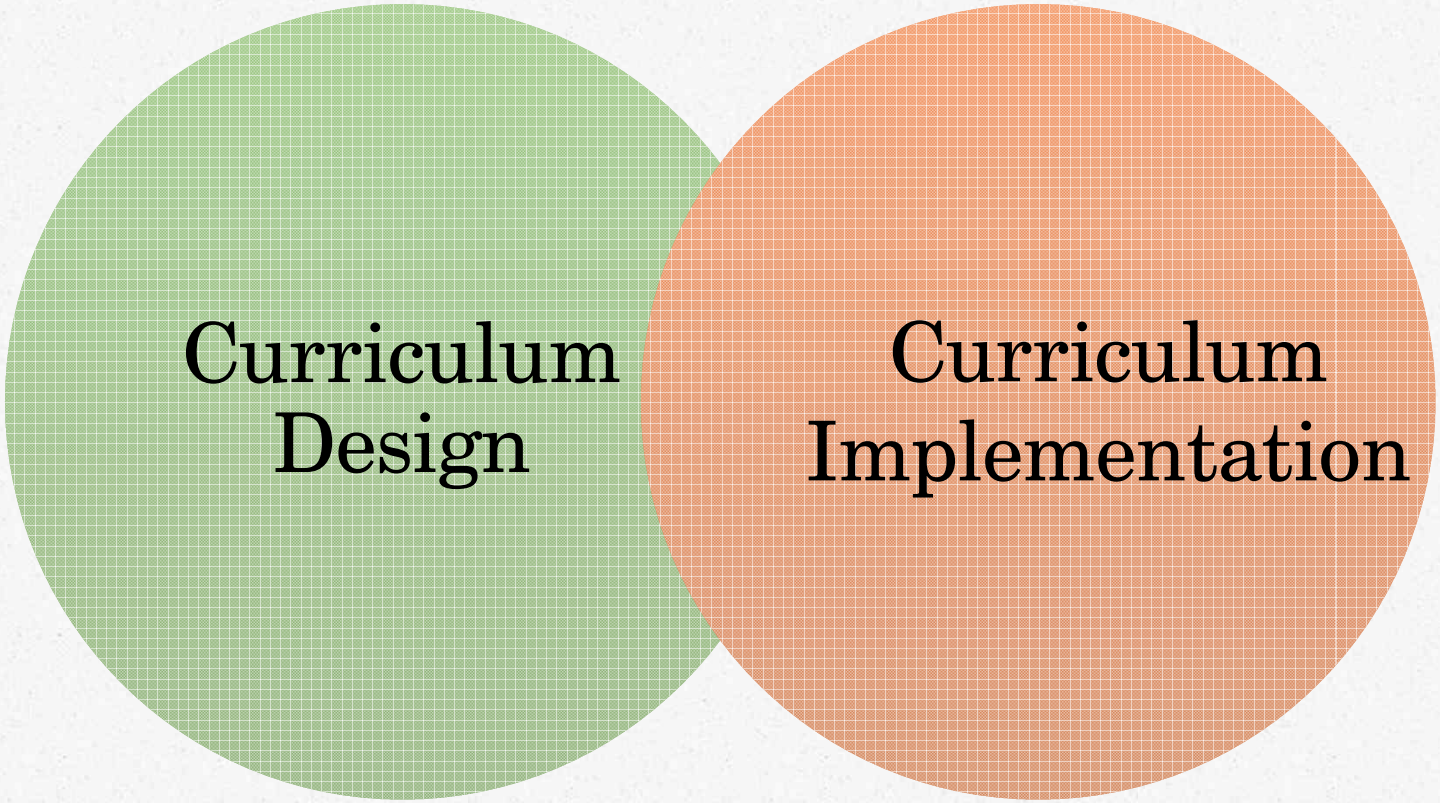
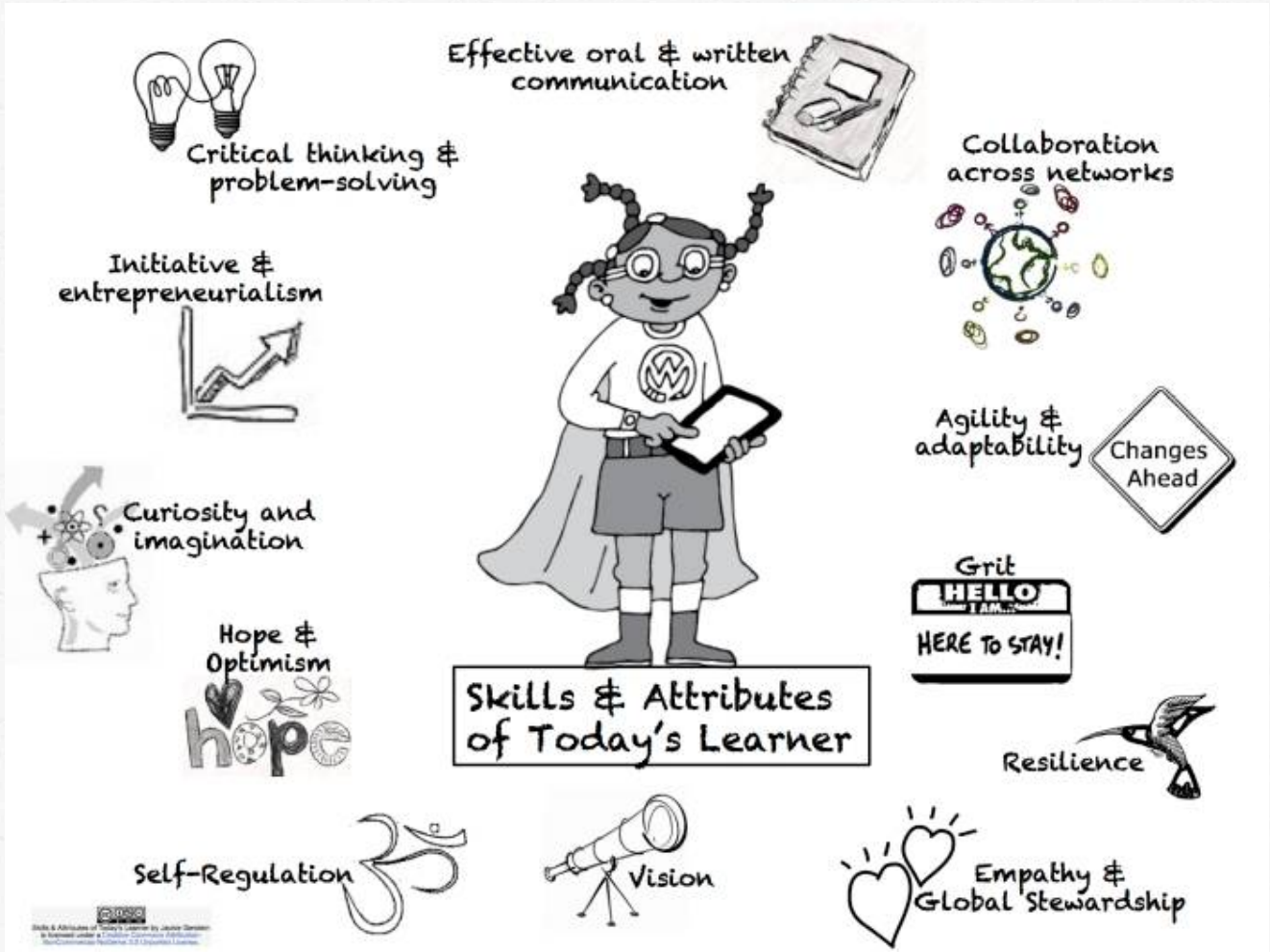
Common Research Concerns



What is required of a 21C citizen?



Needs of Public understanding of science & Multidisciplinary work

- *(Even) Many personal decisions, for example about diet, vaccination, personal hygiene or safety at home and at work, would be helped by some understanding of the underlying science. Understanding includes not just the facts of science, but also the method and its limitations as well as an appreciation of the practical and social implications. A basic understanding of statistics including the nature of risks, uncertainty and variability, and an ability to assimilate numerical data are also an essential part of understanding science. (The Royal society of London, 1985)*

- In the 1980s
  - UK Royal Society, American Association for the Advancement of Science (AAAS)
  - Institutionalized public understanding of science: the better public understanding of science can be a major element in promoting national prosperity, in raising the quality of public and private decision-making and in enriching the life of the individual….Improving the public understanding of science is an investment in the future, not a luxury to be indulged in if and when resources allow.

Public understanding of science

- National prosperity (ex. trained workforce)
- Economic performance (ex. beneficial effect on innovation)
- Public policy (informing public decisions)
- Personal decisions (ex. diet, GMO, food choice)
- Everyday life (ex. what goes around us: politics, daily matters)
- Risk and uncertainty (ex. nuclear power, BSE)
- Thought and culture (science as a rich area of human inquiry and discovery)

Republic of Science and Technology

- **Underlying belief about science and technology: value-neutral enterprise**
  - **Integrity of science**: Scientific practices such as observation and experiment, theory construction, and inference are not influenced by political and social values.
  - **Autonomy of science**: Scientific inquiry proceeds undisturbed and unaffected by the values and interests of its social and cultural context (internal momentum of science—eg, science as a self-sustainable island)

Science, Communication, Public

Science and the Public

Why Every Lab Should Tweet ?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피부 재탄생의 비밀
DANAHAN GENE-ACTIVE
다나한 젠 액티브
메디포스트와 다나한이 피부재탄생의 비밀을 밝힙니다


THE POWER OF
STEM CELLS
These innovative Anti-Ageing creams restore our skin`s STEM CELLS, accelerating cell renewel and slowing the skins aging process.
CORPORE SANO
REGENERATING CREAM
Corrects signs of ageing
CREME REGENERADORA
STEM CELLS
from Red Grape

Research Questions

- RQ1. What social-scientific issues (SSIs) are relevant to higher education?
- RQ2. How can we teach SSIs to undergraduate and graduate students?

  - To students: 1) Non-science majors: Introductory biology
    2) Science and engineering majors

Socio-technical issues and curriculum

- To whom:
  - Science and engineering majors, non-science majors at the university level
- What to teach:
  - Socio-technical issues of science and technology
  - Multifaceted aspects of science and technology in society
  - Interplay of science and technology with society

Case 1: Introductory Biology

<Given socio-scientific issues>

- Snack company's false report on diet issues
- Problems with recycling system
- Punishment standards for mentally disturbed criminals
- Public beliefs on organic foods
- AIDS/HIV patient rights vs. the rights of small and weak nations
- Setting permissible limits on human replication

Advantages of SSIs

- Their level of argumentation was improved
  - To consider complex features of SSI
  - To build more sophisticated discussions
  - To actively engage with ongoing discussion
- Their knowledge is alive
  - Frequently recalling, interpreting and integrating prior knowledge
- The discussion Invite students into the classroom
  - Every student can bring his/her own experience into group thinking process
  - Ideally, the discussion gives a chance to provoke scientific curiosity and guides to pursue related inquiry
- Their communication gets mature.
  - No more passive listener. And their Roles (Asking questions, giving sophisticated explanation, showing skepticisms, making encouraging mode etc) were not fixed. Distributed leadership and responsibility.

Barriers of SSI

- The quality of argumentation still depends on the topic (ex. Diet food vs. stem cell research). Discussion-not-needed self-evident answer or strongest personal opinion.
- Can't handle the time with ambiguity and regarding the discussion activity useless.
- ➔ Need persuasion: the value of communication and the social nature of scientific enterprise.

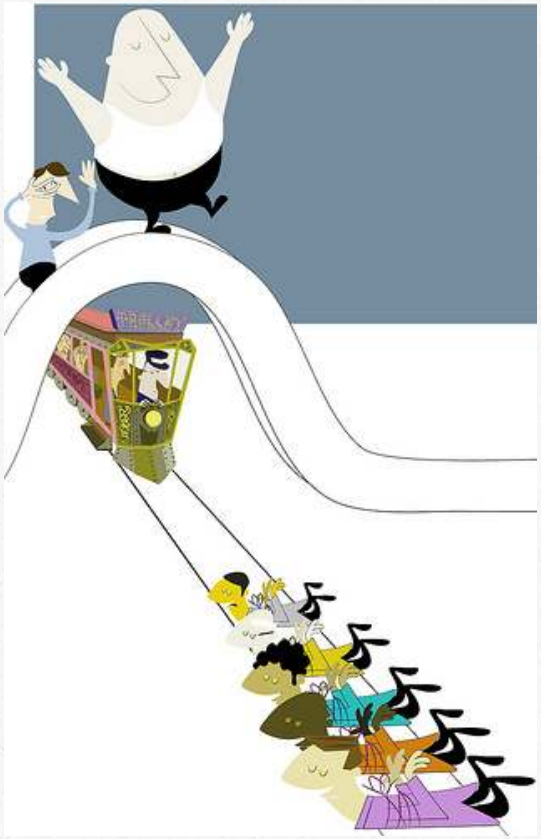
Case 2: Engineering ethics and communication

- Engineers as public intellectuals
  - Globally competent citizen and opinion leader
- Science, technology, and public policy
  - In ‘public’ domains: scientific and technical knowledge provides a framework to shape public appreciation and debate
  - Framing: public values embedded
- Ethical issues: policy, legal, regulatory issues
  - Ethical decision-making requires cultivating the habit of reflecting carefully upon the range of stakeholders who together make up the ‘public’ to whom I am obligated, and weighing what is at stake for each of us in my choice.

Case 2: Engineering ethics and communication

- Ex. Selected themes from science and technology studies, Space shuttle disasters such as Challenger and Columbia, Love canal disaster, Data and machine ethics, bioethics, gender and technology, student case presentations

Case 2: Engineering ethics and communication: Thought experiment



- Hypothetical situations have dominated the public debate around the social impacts of AI: responsibility and culpability
  - ex. trolley problem
  - ex. Driverless cars: moral machines at MIT

Case 2: Engineering ethics and communication : Thought experiment

- Does it help to think about and answer wider social issues:

  ex.

  - 1) the value of a massive investment in autonomous cars rather than in public transport;
  - 2) how to secure its safety before public use and how to assess and measure its safety (cf. safety belt, air bag, etc);
  - 3) the potential effects of autonomous vehicles on congestion, the environment or employment.

Moving forward

- Should the two students groups be treated the same or differently (in terms of the content and method)?

Ultimate Goals

- A bridge between science education and science communication via curriculum reformation