Remote laboratories: lessons from the literature
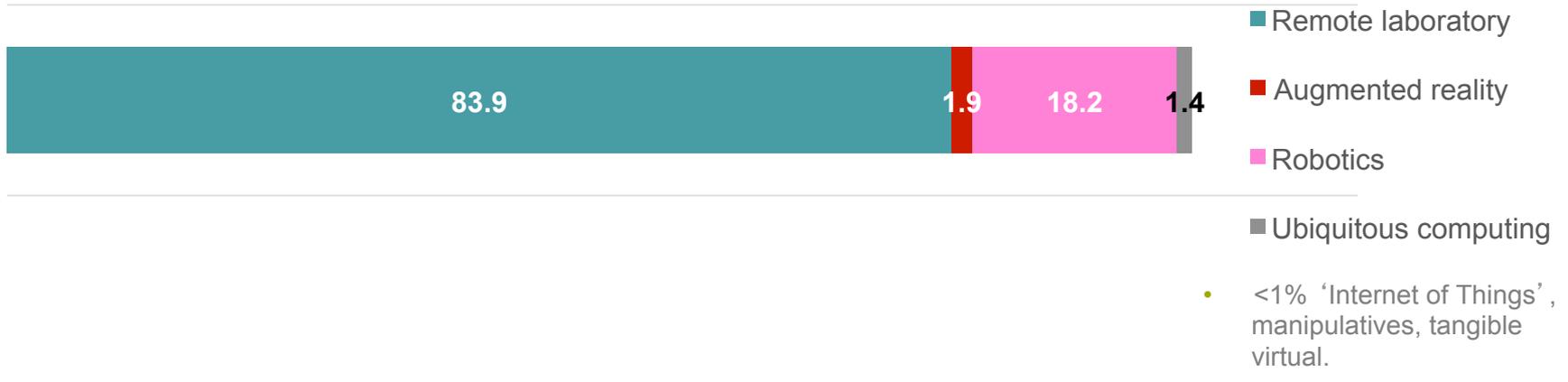
The Open University
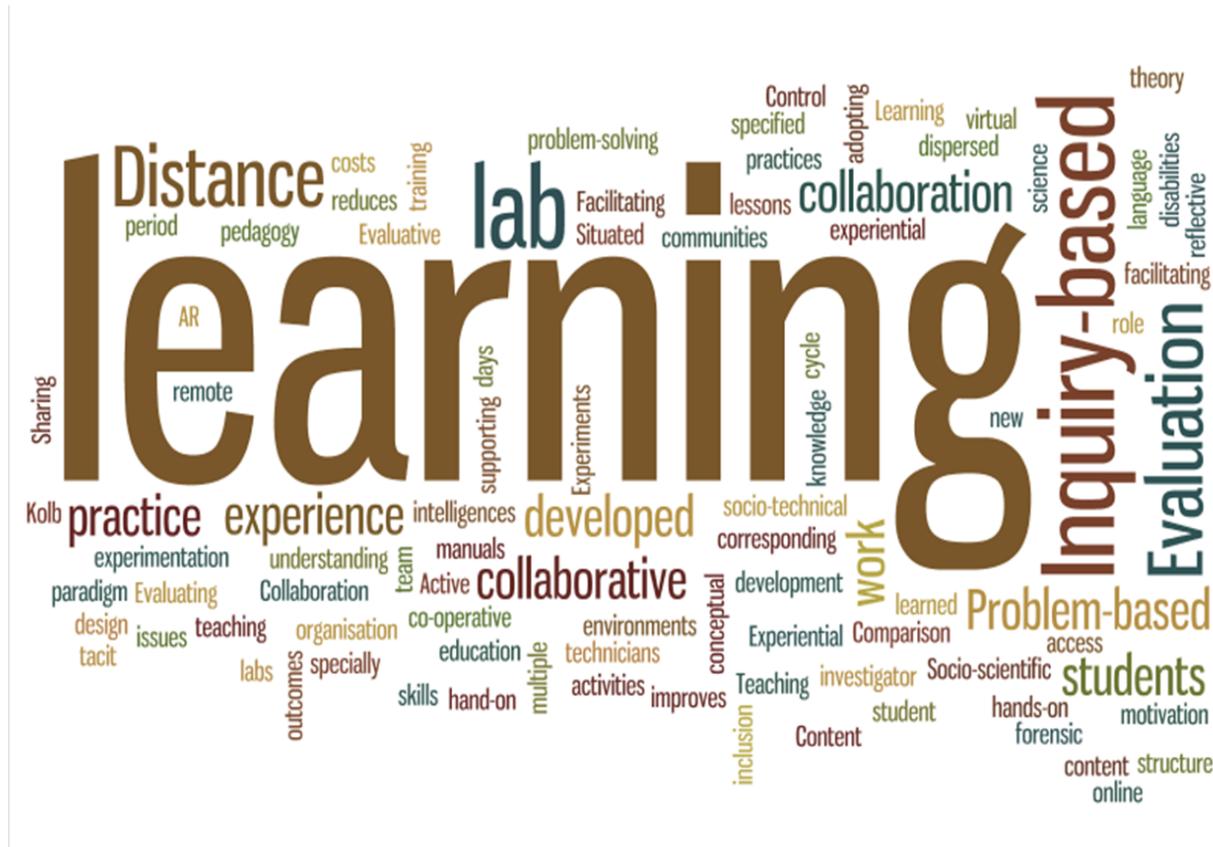
Introduction and Aims
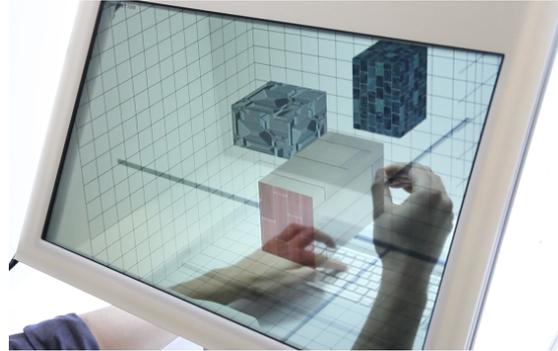
- Project aims: review 'digital / material hybrid' systems in learning

- Systematic literature review of 'state of the art':
  - digital/materiality,
  - networks
  - learning

Stage 1

DIGITAL/MATERIALITY SEARCH TERMS

83.9	**1.9**	**18.2**	**1.4**

- Remote laboratory
- Augmented reality
- Robotics
- Ubiquitous computing
 - <1% 'Internet of Things', manipulatives, tangible virtual.

- A lab with one set of experiments for an inverted pendulum and another for coupled water tanks
- RePhys, an example of a hybrid used in biomedical and physiological systems studies with sensors for remote monitoring of blood pressure, heart rate etc along with webcam along with webcam
- Telecommunications systems labs involving switches and routers
- Webcams and microphones to allow students to observe experiments remotely

3

Stage 1

PERCENTAGE OF PAPERS BY DISCIPLINE, FOCUS AND TYPE OF PAPER (n=808)
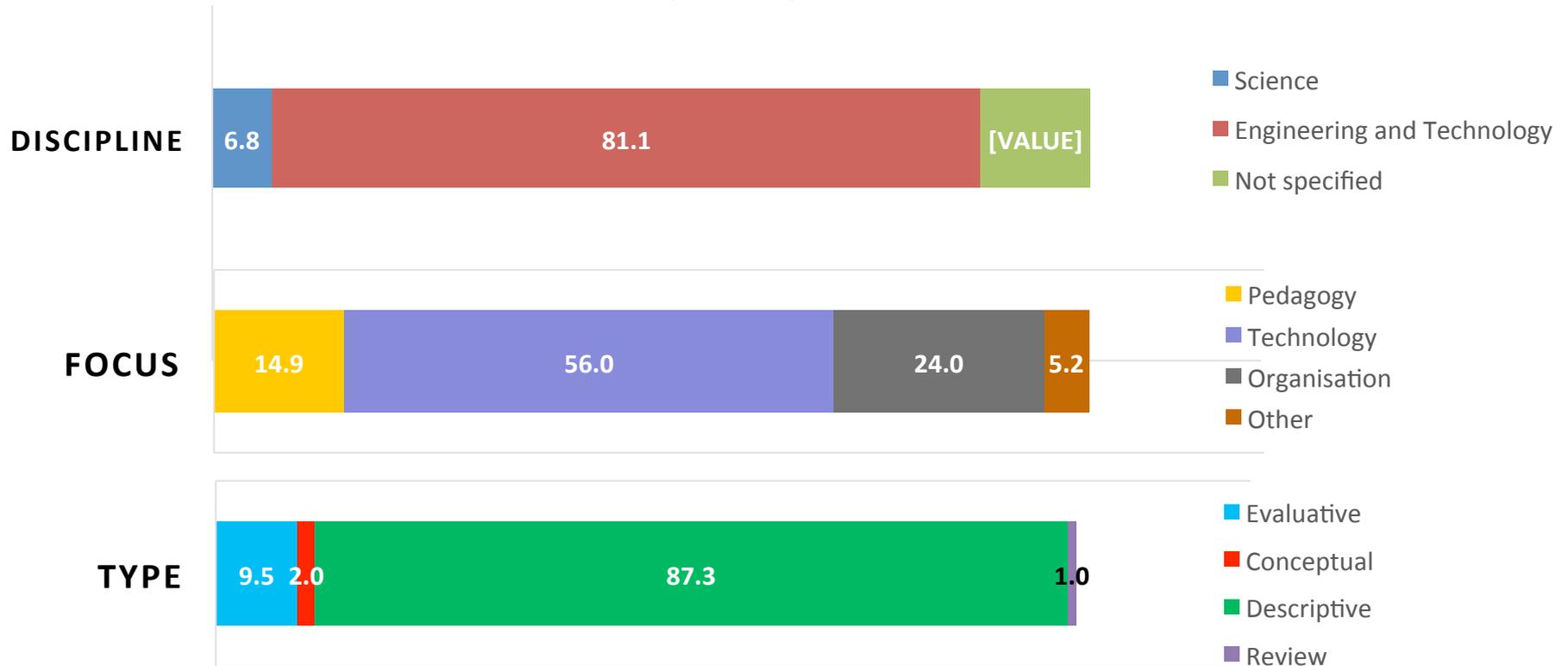
Stage 2

- In-depth text review of a subset of the papers (n=29)
  - remote laboratories
  - evaluative and pedagogical issues
  - review papers

3 themes emerged

1. the importance of real data and authenticity in learning
2. the importance of a sense of presence
3. the locus of control in, and responsiveness of, a hybrid system

1.Real data and authenticity

- possibility of 'learning from failure'

- 'real world' experience of dealing with uncertainty and 'noise'

- more motivating to have uncertain outcomes than those 'already known'

- 'real labs' have time and space constraints

- remote materiality offers advantages over entirely digital virtual or simulated

2. A sense of presence

- immersion – sense of immediacy and control
- telepresence – sense of being there
- social presence – being there with others
- design – closeness of interface to real world system

3. Locus of control & responsiveness

- active involvement
- who controls the experiment
  – teacher demo, student, batch runs, scheduling
- responsiveness and feedback in a system – bandwidth issue

Conclusions

- Few pedagogical, evaluative studies = the field is still maturing

- Lessons about effective learning through remote laboratories

- New remote laboratories offer a lens with which to view
  - more traditional material pedagogies, e.g. lab-based,
  - and purely digital pedagogies, e.g. virtual labs.