

EVALUATING THE IMPACT OF RESPONSE TECHNOLOGY ON STUDENT ENGAGEMENT AND ACHIEVEMENT



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OVERVIEW

- ◆ Introduction
- ◆ Formative Teaching
- ◆ Methodology
- ◆ Results: Impact on Student Experience, Engagement and Achievement
- ◆ Explanation of Impact
- ◆ Conclusion
- ◆ Future Work

LOUGHBOROUGH UNIVERSITY

- ▶ 2009: Celebrating 100 Years of Education and Innovation
- ▶ Formed as a Technical Institute in 1909, received its Royal Charter in 1966
- ▶ 23 departments with over 16,000 students & 3,000 staff
- ▶ including over 2000 international students from over 100 countries
- ▶ The University is organised into three Faculties:
 - ▶ Engineering
 - ▶ Science
 - ▶ Social Sciences and Humanities



1909 - 2009
100 years of education and innovation

MATHEMATICS EDUCATION CENTRE

- ▶ Established in 2002
- ▶ Teaching of mathematics to engineering undergraduates
- ▶ Mathematics Learning Support Centre (Centre for excellence in Teaching and Learning)
- ▶ Innovative uses of technology in mathematics education
- ▶ Research focus and expertise in higher education



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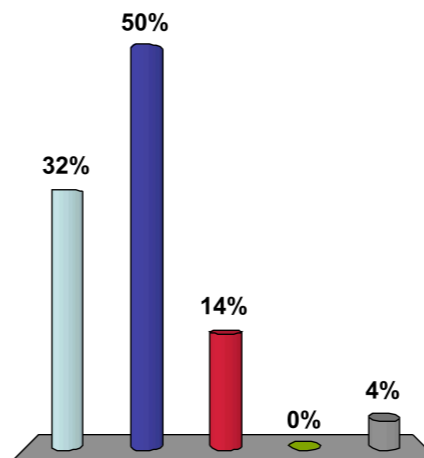
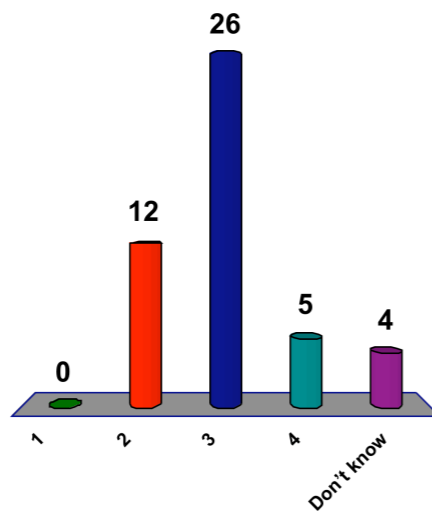
WHO WANTS TO BE A MILLIONAIRE?



Handset



Dongle



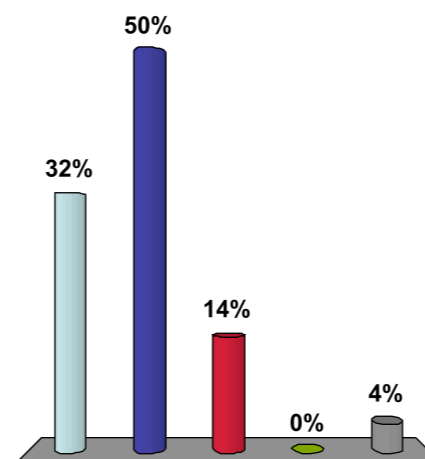
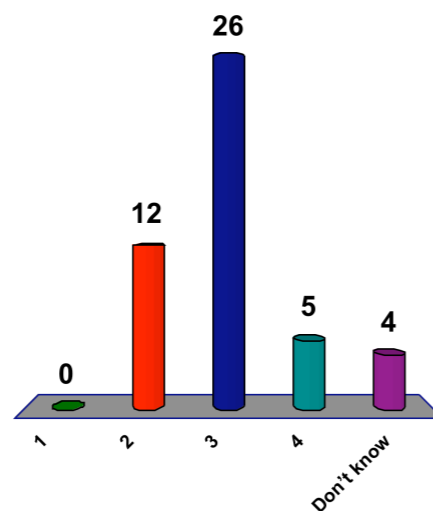
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- Students using clickers to answer questions during a lecture

OVERVIEW - CLICKER USE

- ▶ UK: Jim Boyle (Strathclyde) and Michael McCabe (Portsmouth)
- ▶ UK-Maths: 12 universities – Bath, Imperial College, Sussex, Southampton, Coventry, Loughborough, Edinburgh, Durham, etc
- ▶ North America: Hundreds of institutions including Harvard, Univ. of Massachusetts, Queens University, BC, etc
- ▶ Major Vendors: TurningPoint, eInstruction (CPS, InterWrite), i>clicker, Promethean, qwizdom, H-ITT

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4. Applications
5. ConcepTests
6. Repeaters

QUESTION TYPE - REVISIONS

- ▶ Bodmas: An example of a revision question given to students on a first-year Sports Technology module

Bodmas $2 - (-5)^2 \div \frac{(-5)}{2} + 11 =$

$$2 - 25 \times \frac{2}{(-5)} + 11 = 2 - (-10) + 11$$
$$= 2 + 10 + 11$$
$$= \underline{\underline{23}}$$

23	6
3	3
1	1
15.5	1
OTHER	5

QUESTION TYPE - REVISIONS

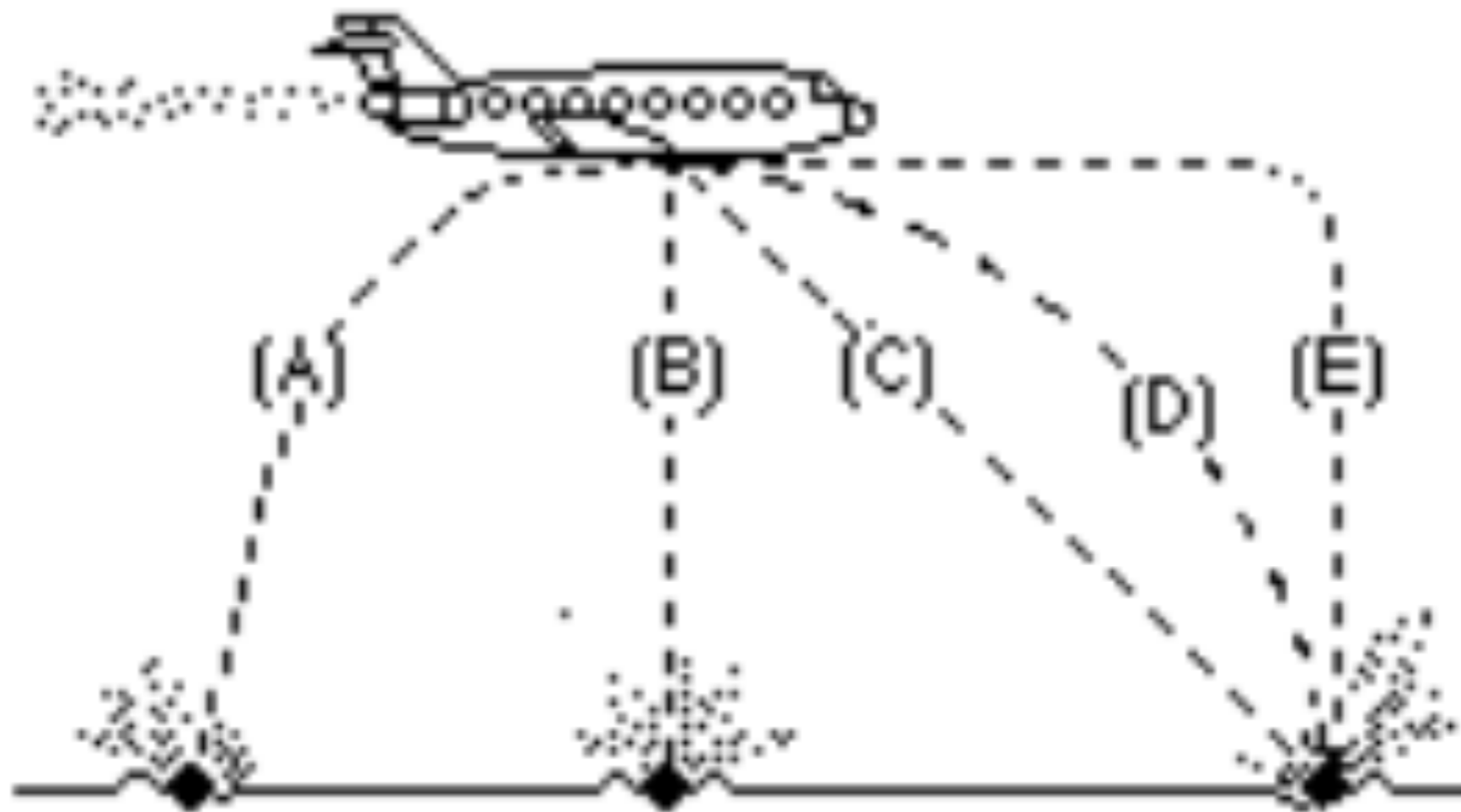
- ▶ **Definition:** To identify student prior knowledge; highlight common student misconceptions and revise previous lecture/topic
- ▶ **These have been used in three ways:**
 1. Review of GCSE/A Level subjects for 1st year students
 2. Review of preceding lecture/topic
 3. End-of-term revisions

QUESTION TYPE - CONCEPT TESTS

✓ To assess conceptual understanding of a sub-topic deemed fundamental or one there is evidence students usually have difficulty understanding

▶ Example

A bowling ball accidentally falls out of the cargo bay of an airliner as it flies along in a horizontal direction. As observed by a person standing on the ground and viewing the plane as in the figure below, which path would the bowling ball most closely follow after leaving the airplane?



METHODOLOGY

▶ Research Question

To evaluate the impact of EVS on student experience, engagement and achievement in university mathematics

▶ Sample

Undergraduate students from Automotive, Aeronautical, and Mechanical Engineering departments

▶ Methods

Observations, One-Minute Questionnaire, Main Questionnaire, Interviews, and Focus Groups

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 - “Reassures you there’s always someone more stupid than you”
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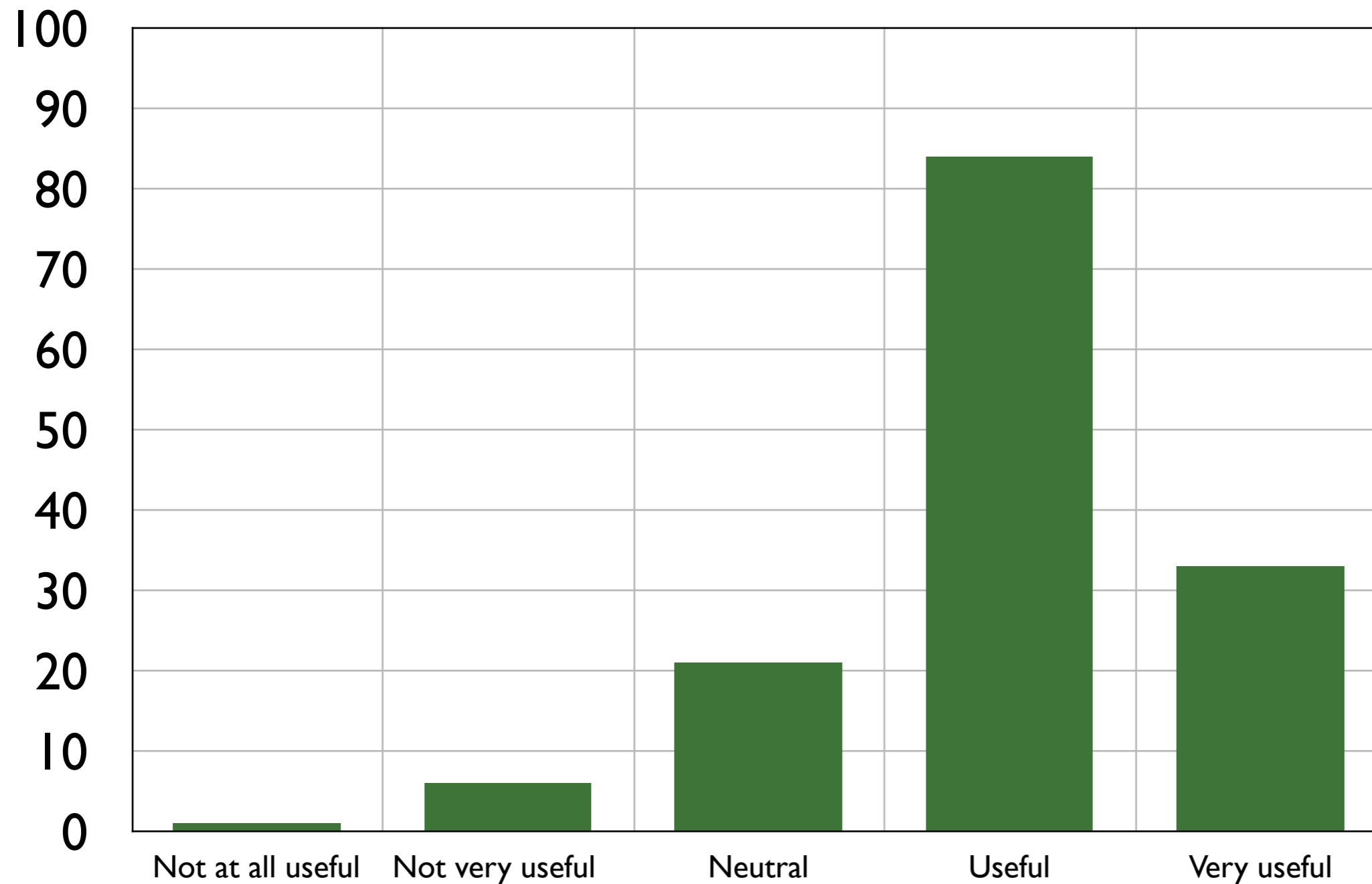
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STUDENT EXPERIENCE

- **ATTITUDE:** 80% of students said handsets are ‘useful’ or ‘very useful’, generally display positive attitudes

Student Perception of Clicker Usefulness



BEHAVIOURAL ENGAGEMENT

- ▶ **Taking cognizance of material being presented** - “In the lecture they ask you questions; make sure you’ve been listening”
- ▶ Retuning ‘checked out’ students – “Keeps people awake due to being interactive; “Stops boredom. Keeps people awake”
- ▶ **Interactivity** - There are three levels:
 - ➔ Surface interactivity: Instructor - Student
 - ➔ Peer Interactivity: Student - Student
 - ➔ Technical interactivity: Student - Clicker
- ▶ **Participation**

COGNITIVE ENGAGEMENT

- ▶ Cognitive Engagement: *Meaningful* engagement or *processing* of lecture material
- ▶ ‘Human copy machines’ (Hamilton, 2007)
- ▶ Student Comment: “*When you go through an example or we are taught something, you might be like: Oh I get that, but it’s not until you do a question that you know whether you can or not*”

STUDENT ACHIEVEMENT

- ▶ Data showing the performance of students on an engineering module who were taught via the clicker-enabled formative teaching mode over a three-year period

COHORT FEATURE	2006/7	2007/8	2008/9
NO. OF STUDENTS	145	147	156
COURSEWORK AVERAGE	81.3	58.9	64.7
EXAM AVERAGE	59.2	62.0	58.4
OVERALL AVERAGE	63.2	60.3	59.7
FAILURE RATE (%)	13.8	14.9	7.7

EXPLAINING THE IMPACT

- ▶ **Question-driven Instruction:** Less motivated students' academic performance improves with 'frequent' questioning (Frase et al., 1970; Guthrie & Carlin, 2004)
- ▶ **Deliberate Practice:** "Unless a student cognitively processes a question and participates in answering it ... learning does not take place" (Thalheimer 2003; Bransford et al, 2000)
- ▶ **Formative Feedback:** Immediate; Corrective; Formulating an answer before receiving feedback; Lecturer loop
- ▶ **Two-year technology window** (Becta, 2007)

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- ▶ May help weaker students (Boyle, 2001)
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FUTURE WORK

- ▶ Survey of academic staff in the UK who use clickers to teach maths
- ▶ Survey of academic staff in the USA who use clickers to teach maths
- ▶ Survey of academic staff in the UK about feedback practices in lectures

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- ▶ Crouch, C. H., & Mazur, E. (2001) Peer instruction: Ten years of experience and results. *American Journal of Physics*, 69(9), 970-977.
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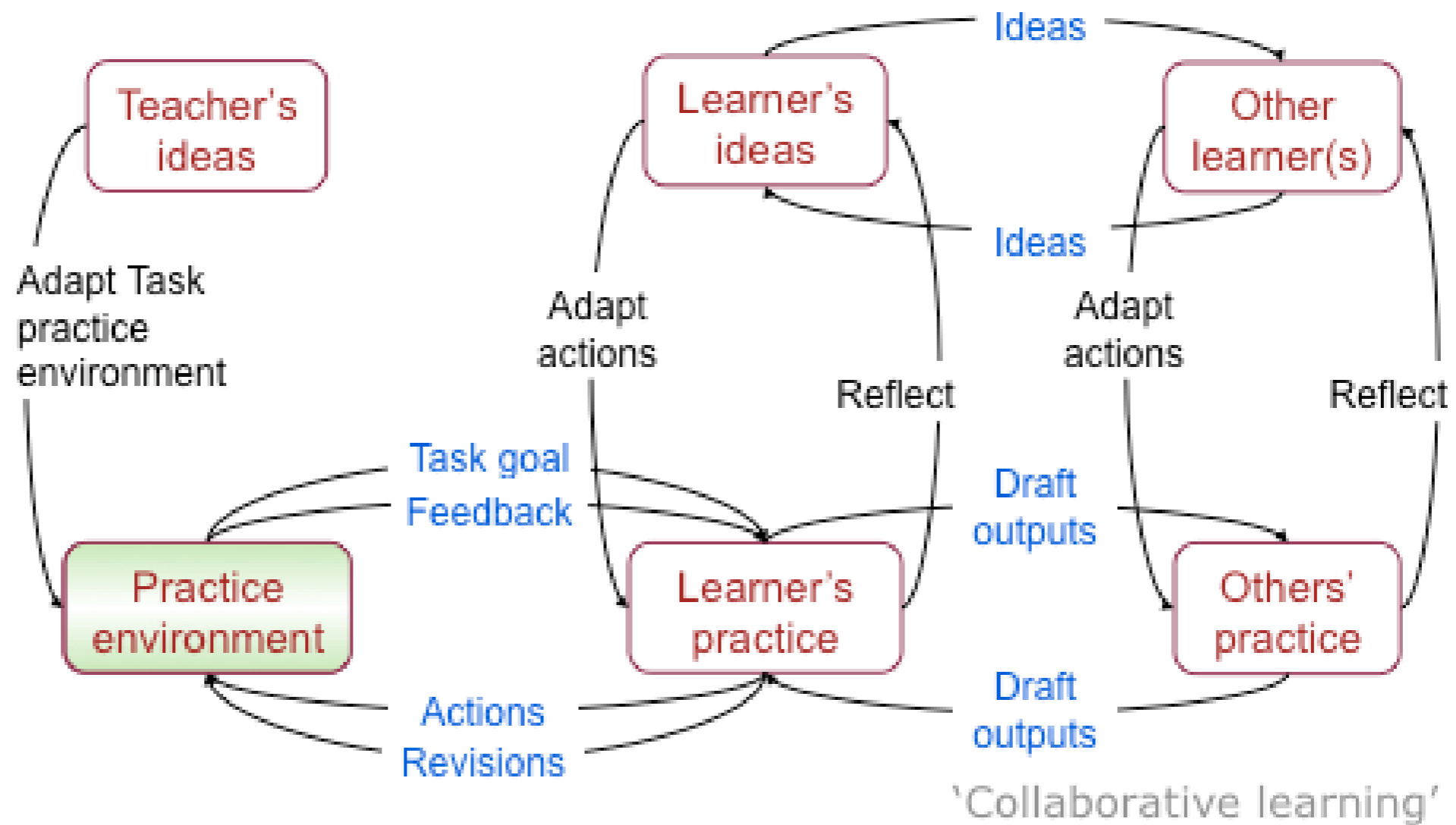
Email: s.o.king@lboro.ac.uk

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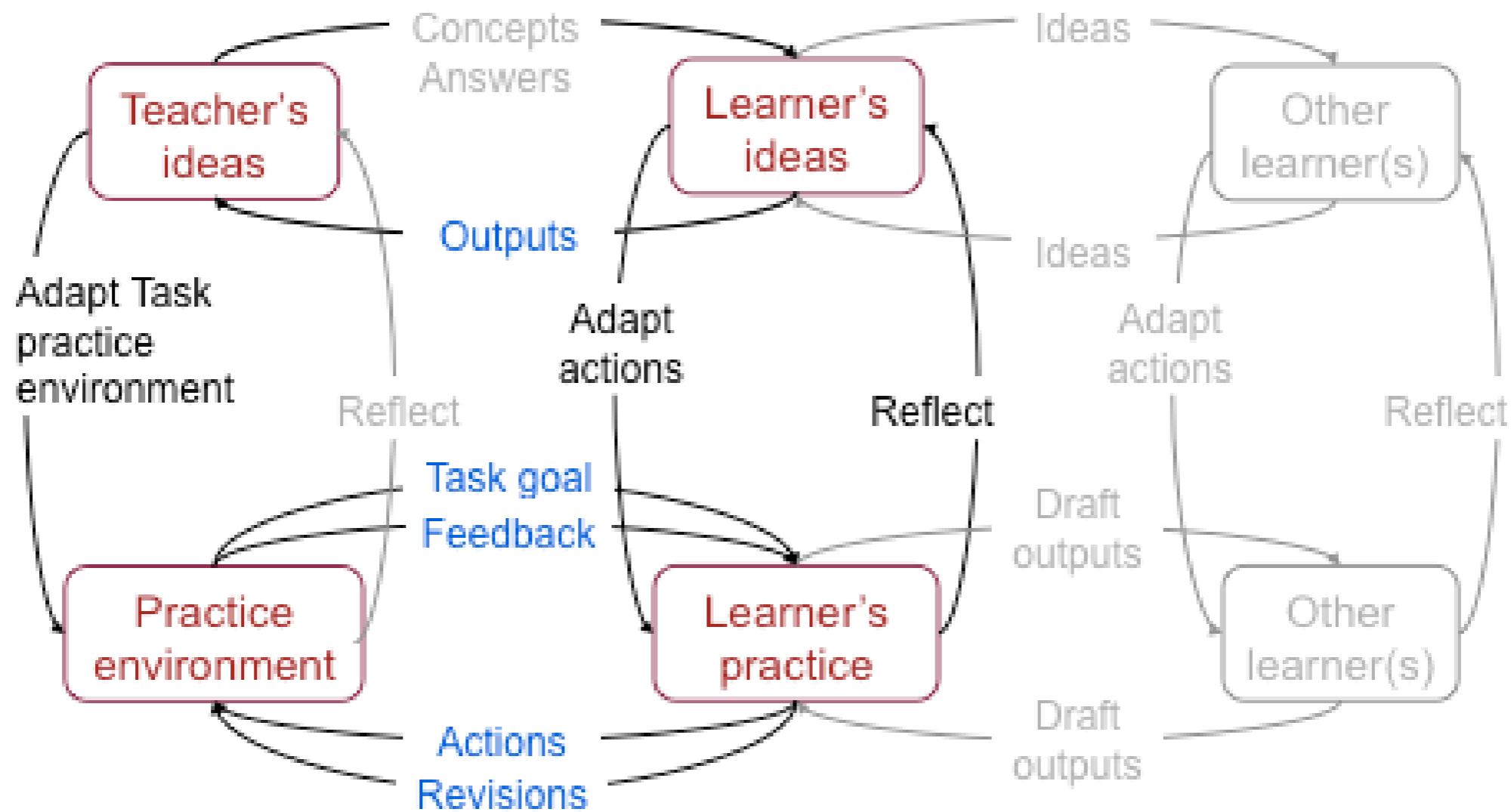
DRAWBACKS

- ▶ **MCQs:** Guesswork; ‘preconceptions of the questioner’ (Abrahamson, 2006); surface learning
- ▶ **Time pressures:** Curriculum redesign; implementation; longer questions
- ▶ **Poor usage:** “Some questions are pointless”
- ▶ **Technical issues:** initial learning curve, software/hardware glitches
- ▶ **Accessibility issues**

A common framework of representation



Learning through *practice*...



Problem sheet, practice exercises, project work...