Design-Based Research: An emerging paradigm for developing theory and Designing innovations

البحث القائم على التصميم: نموذج إرشادي صاعد لتطوير النظريات و تصميم الابتكارات

Nasser Mansour

outline

- Introduce yourself
- Activity 1: Theory and practice
- DBR
- Reflection on the use of DBR
- Reflection on the use of DBR
- Examples on DBR
- Conclusion
- Questions

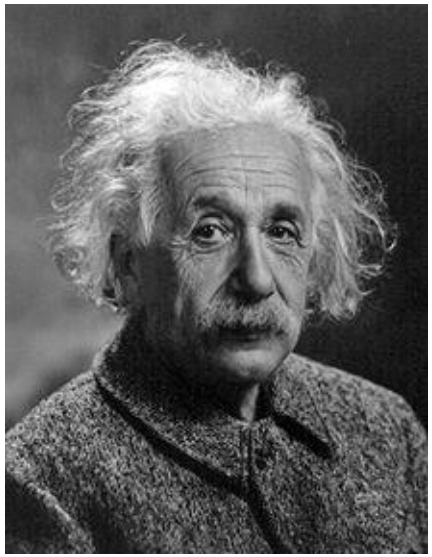
A gap between educational research and praxis

Discuss in groups:

Moving research/innovations into practice: why it is so difficult?

How can we make it possible?

Thinker versus Tinker



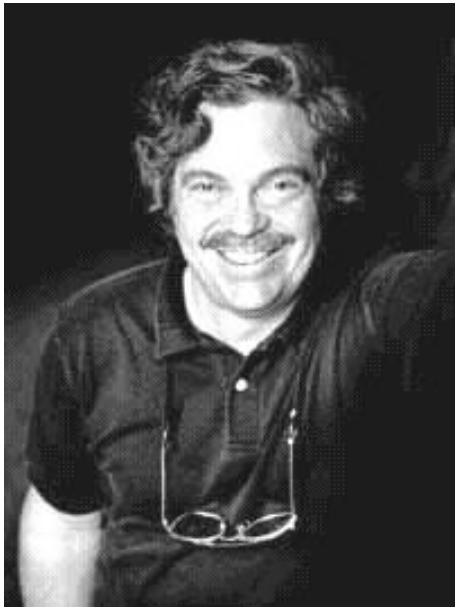
Albert Einstein (1879-1955)

"I never think of the future. It comes soon enough."

"We can't solve problems by using the same kind of thinking we used when we created them."

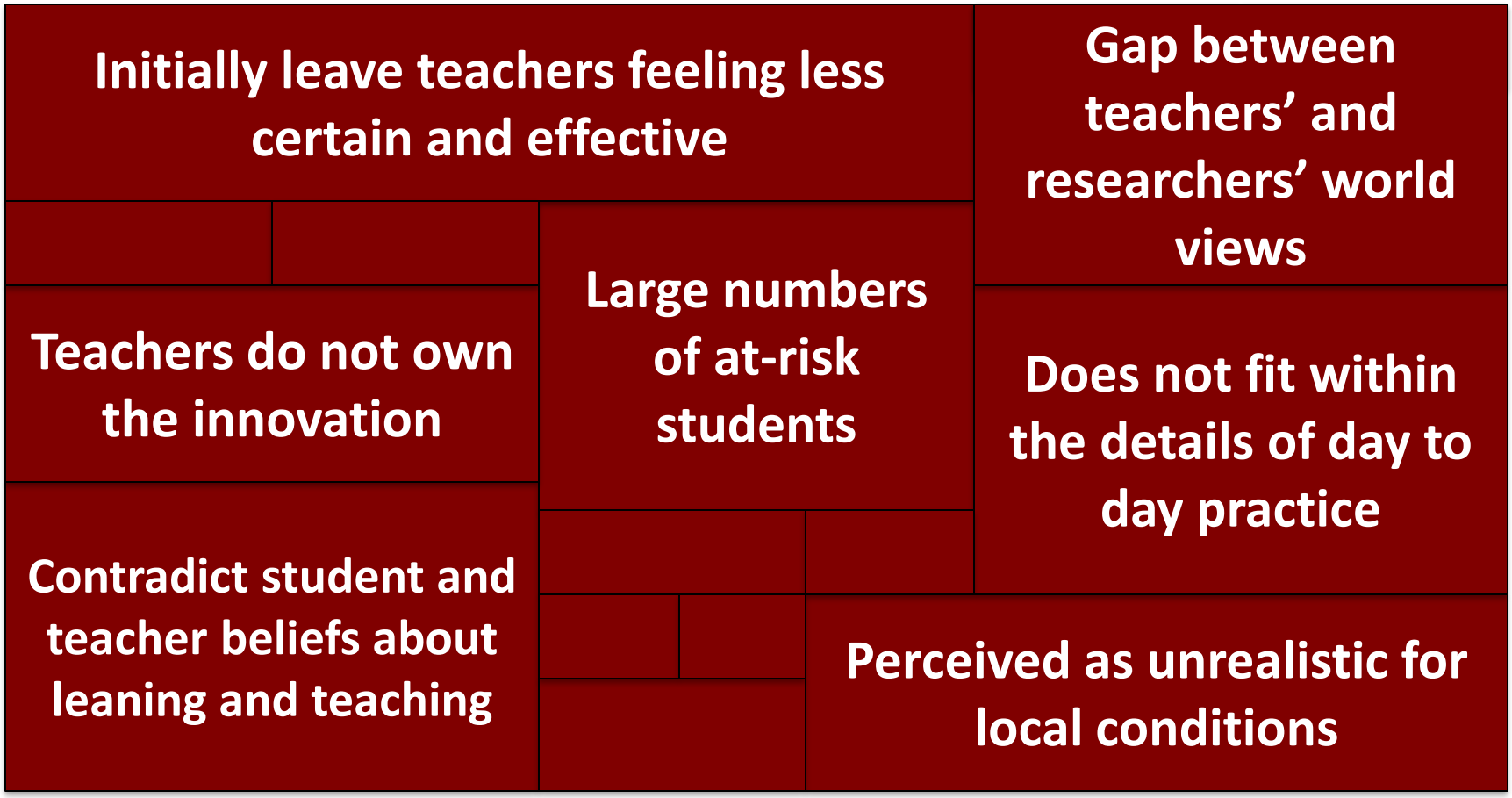
"The whole of science is nothing more than a refinement of everyday thinking."

"Don't worry about what anybody else is going to do… The best way to predict the future is to invent it. Really smart people with reasonable funding can do just about anything that doesn't violate too many of Newton's Laws!" (1971)

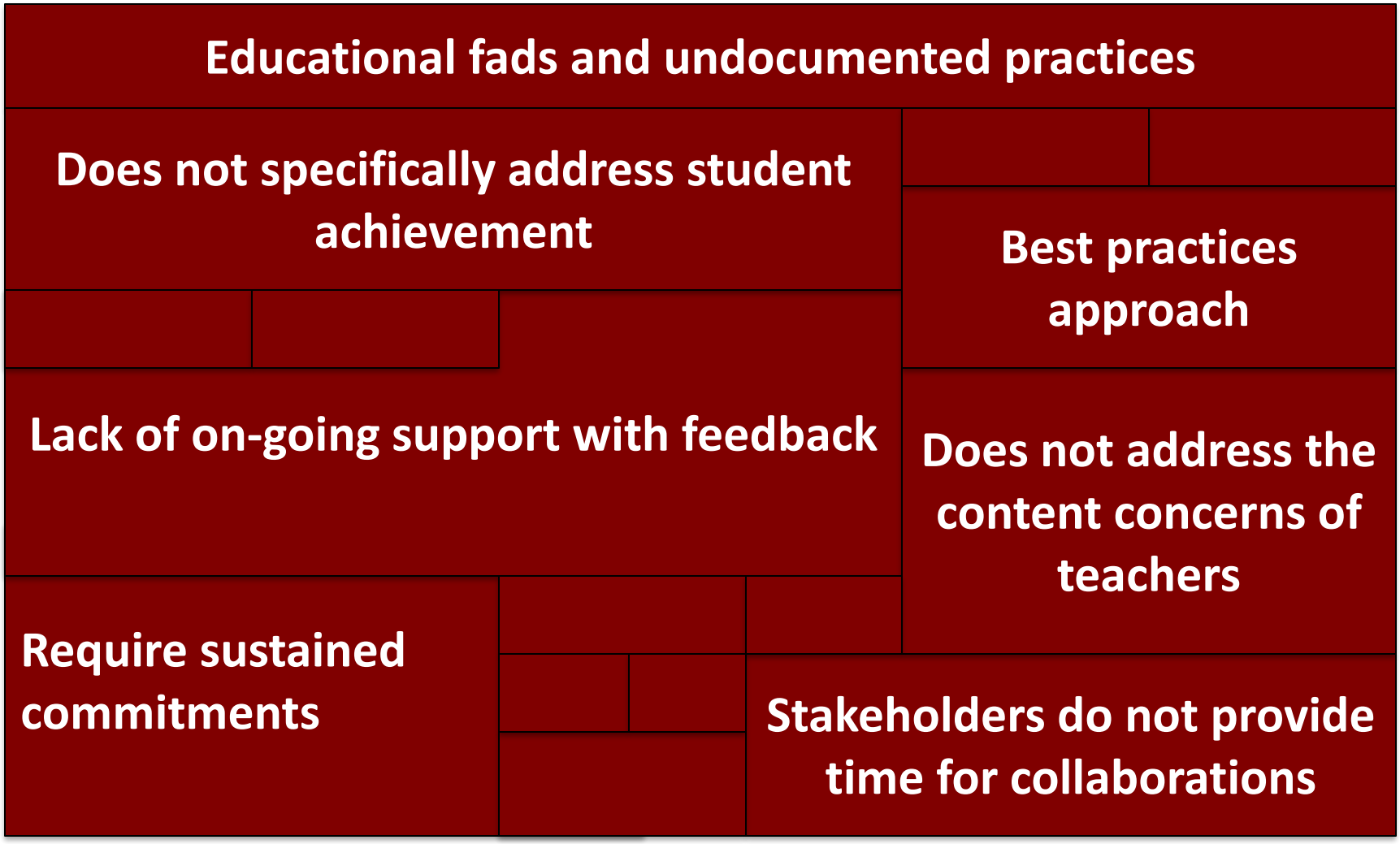


Alan C. Kay (1940-) age 70

Barriers to Innovation



Barriers to Innovation



The gap between educational research and praxis

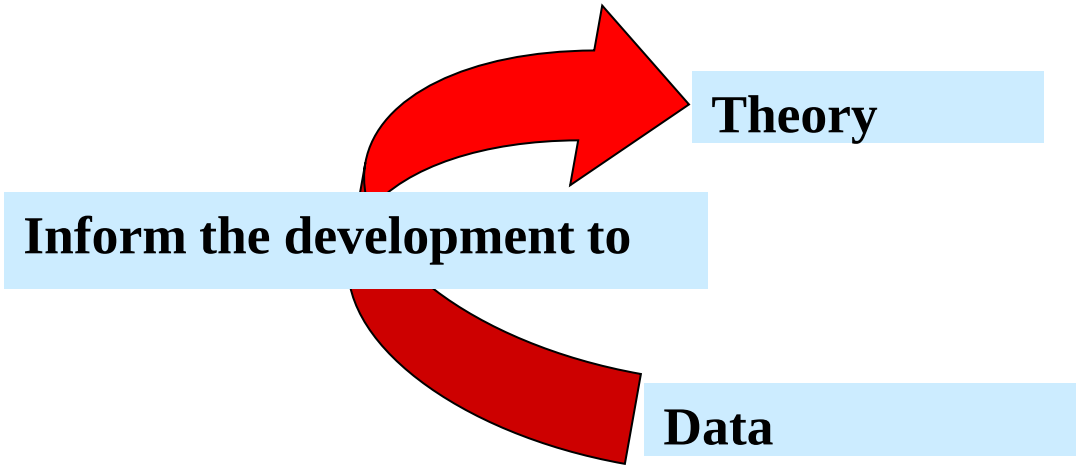
- Teachers tend to express opposition to the innovations suggested by researchers. (cf. Fullan, 1991).
- Teachers appreciate research results obtained from quasi-experimental design because they think that it proves whether a new learning environment or a new pedagogical approach is better in some way than previous ones (Ratcliffe et al., 2005).

The gap between educational research and praxis

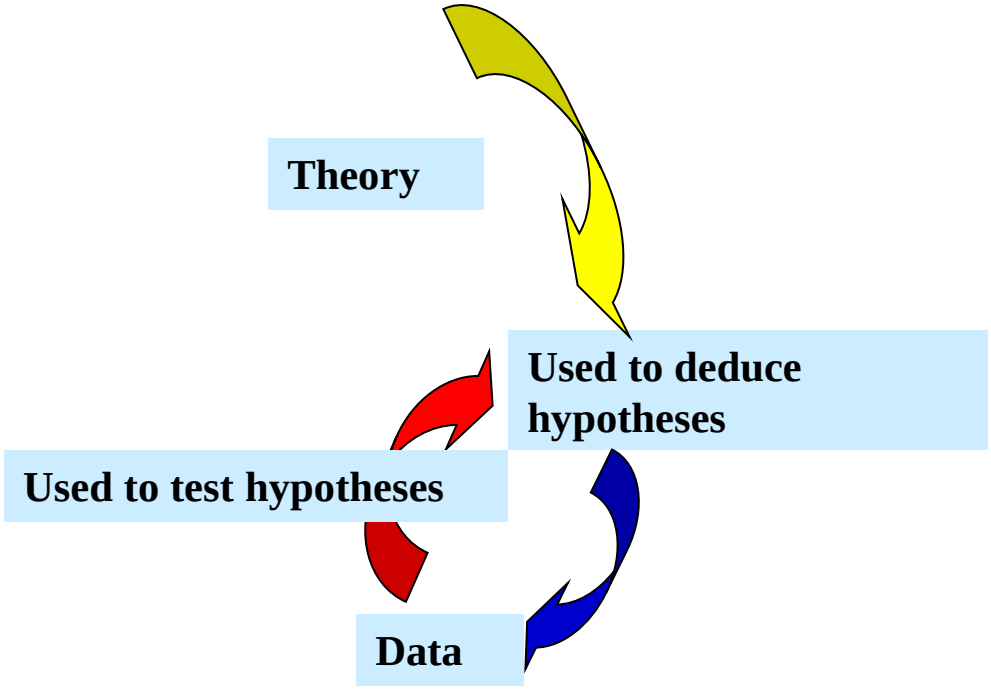
- in the field of educational technology or curriculum or even continuing professional development there is much design not based on research (Randolph, et al., 2005).
- design perhaps, is based on a designer's own experiences and beliefs of effective learning or design is purely technology driven. Even if the design is based on theory, (i.e. research-based practice), teachers' may think that the introduced artefact may work well in the designers' context, but not at all in an authentic real-life setting i.e. their school context .

How do we get theories?

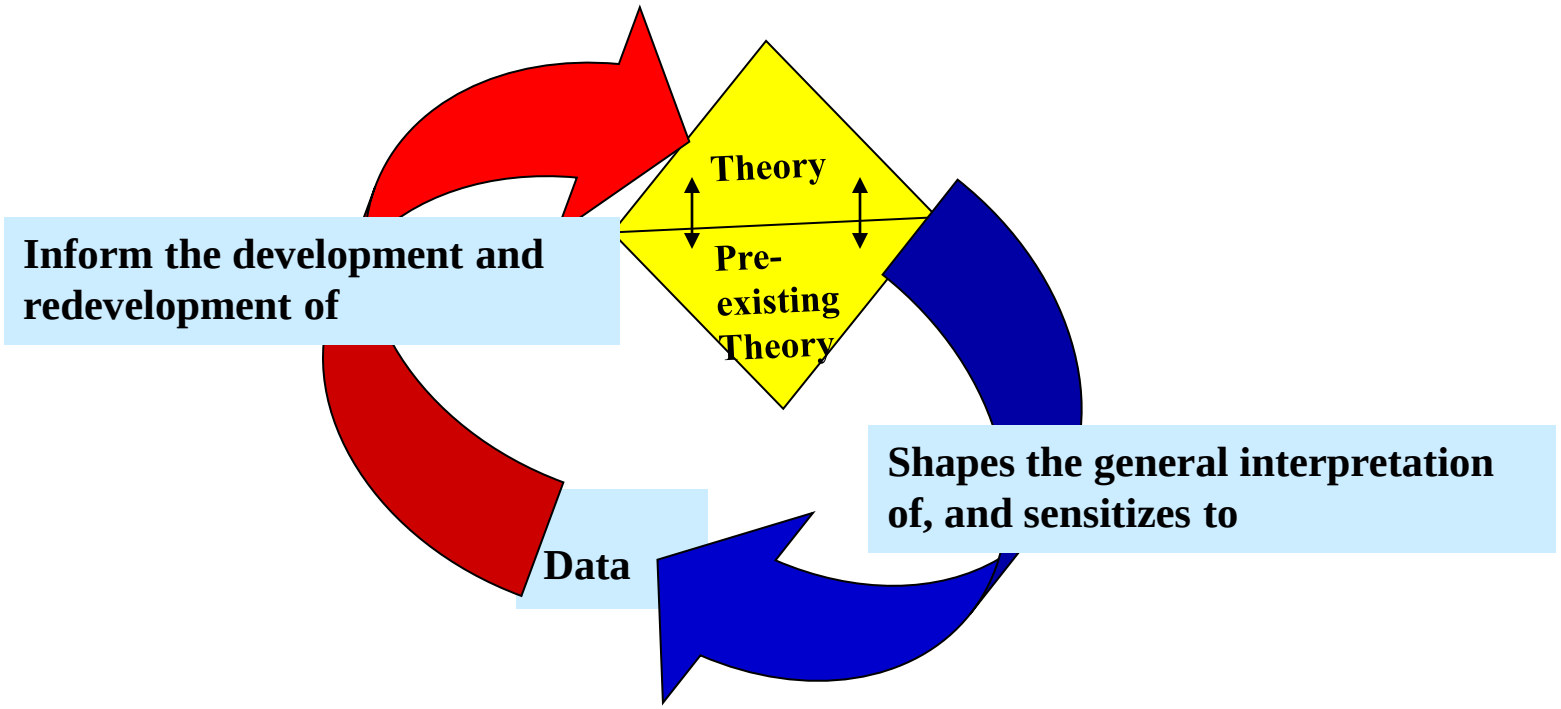
Simplistic inductive theory Building



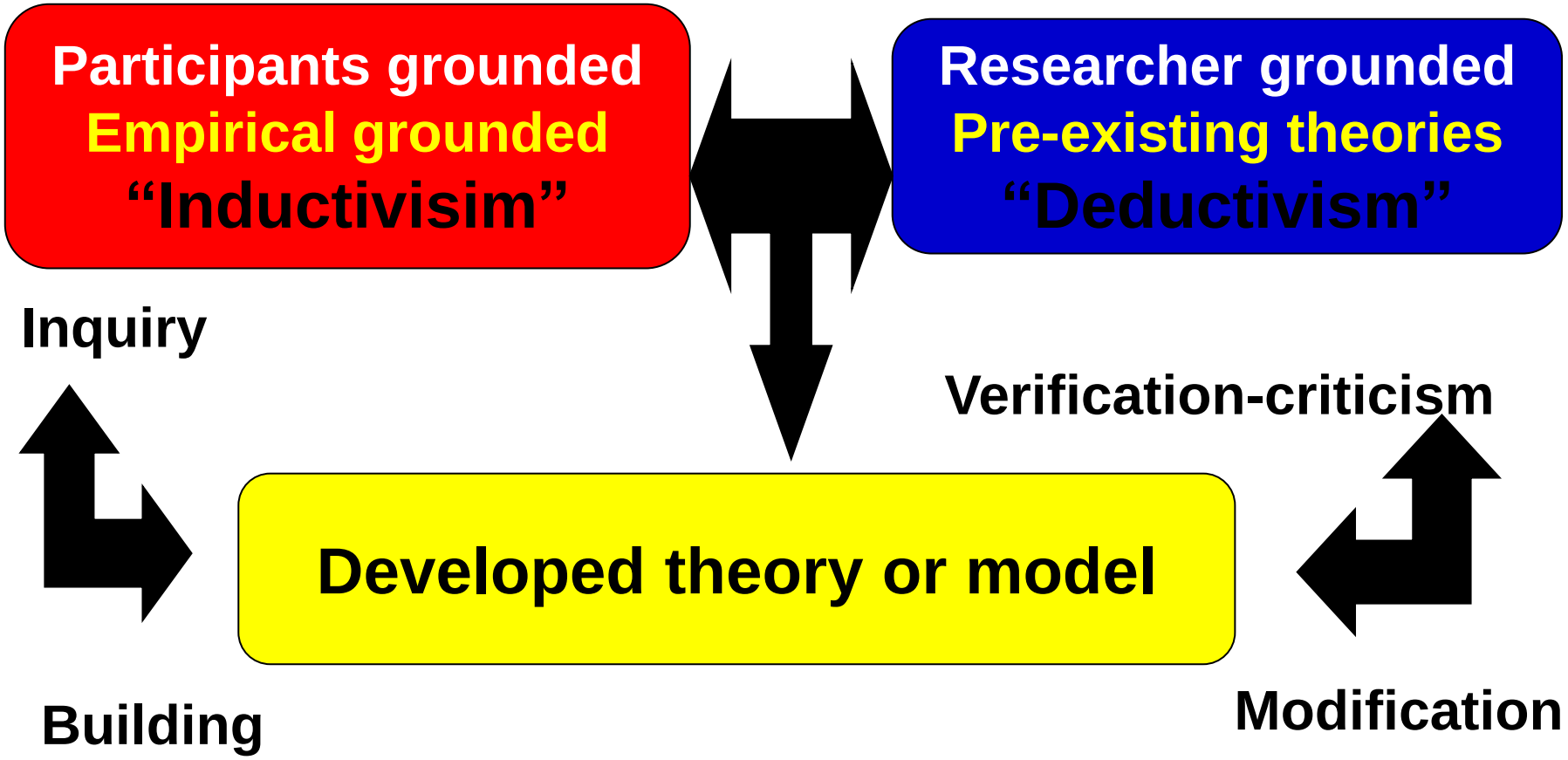
Deductive Theory Building



Constructivist Grounded Theory: a sophisticated model



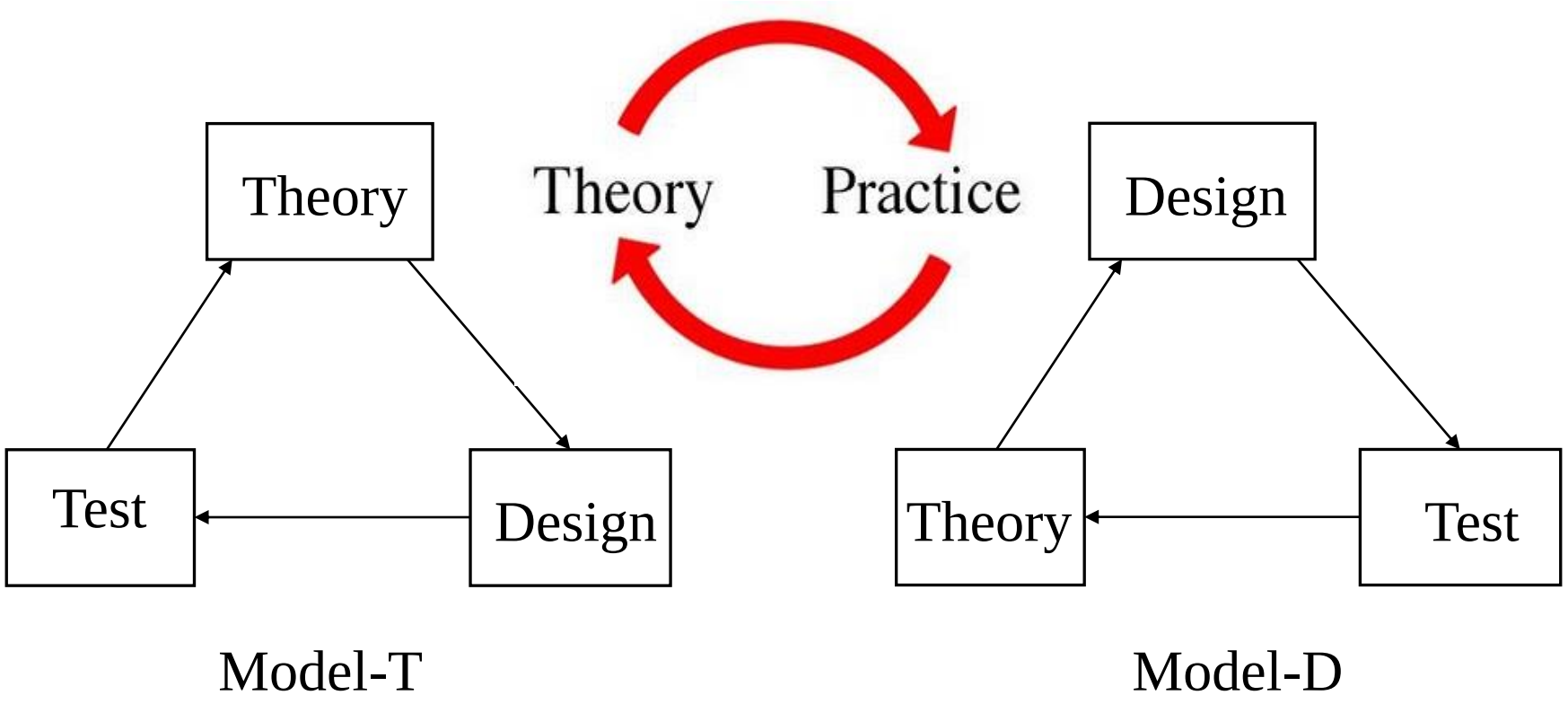
Two grounds instead of one



The Key Argument underpinning DBR is ‘killing two birds with one stone’

Educational design research can make contributions both to educational practice (through useful new designs) and theory (through the testing and improvement of embodied theories, and the explanation of outcomes) (O'Neill, 2012).

What kind of knowledge?



Design-Based Research Methods in Education

Introduction

- Design Research is increasingly less research *about* or *for* design and more research *through* design.

➢ Research *about* design

  ➢ Researching designers/teams and their practices

➢ Research *for* design

  – Original (primary) research into stakeholders' needs, wants, aversions, aspirations etc., technical opportunities, trends, etc.

Overview of DBR

- Driven by problems of practice
  - Research *of* and *for* practice, not research *to* practice.
  - Collaborative research with practitioners
- Goals
  - Implement innovative designs for learning in practical settings
  - Use these designs as contexts for research on teaching and learning
- Method to link observed outcomes to processes of enactment
- Assumes that local context profoundly impacts implementation
  - Places limits on generalization of findings

The Name(s)

- **Design-based Research:** It combines the designing of an educational artefact and research concerning the learning in the designed settings. Recently, several groups have been active in endeavour combining the design of an artefact (at least a teacher guide or a synopsis of a teaching sequence) and educational research using several names
  - Design-based Research Collective - Northwestern (2003)
- **Design Experiments:** emphasises the comparison of several versions of designed artefact
  - Ann Brown – Berkeley (1992)
  - Allan Collins – Northwestern (1990/92)
  - Paul Cobb – Vanderbilt (2003/2006)
- **Educational Design Research (book):** emphasises the process, the features of an artefact and educational knowledge (theory) development .
  - Van den Akker – The Netherlands (2006)
- **Design & Development Research:** emphasises the analysis an artefact or a successful design process
  - Richey & Nelson, 1996
  - Richey & Klein (2007) book
- **Formative and Design Experiments (book)**
  - Reinking & Bradley (2007)

user-design research: emphasises the role of user and focus on information system (software) design Carr-Chellman & Savoy (2004)

(Typical) Three Phases of Design-based Research (Cobb et al, 2003)

- Phase I
  - Preparing for a Design-based Research study
- Phase II
  - Conducting a Design-based Research study
- Phase III
  - Conducting a Reflective Analysis

(Typical) Three Phases

- **Phase I - Preparing for a Design-based Research study**
  - Ground study in literature establishing theoretical intent
  - If possible engage in ethnographic study of the existing learning ecology
  - Specify researcher assumptions about the design
    - Are you proposing an alternate view of the curriculum domain?
  - Set out as clearly as possible the envisioned form of learning
  - Develop an "embodied" design conjecture – one that is testable (starting point/trajectory/end point)
    - "How do you think your design/model will work?"
    - "What shifts do you anticipate and what will influence them?"
    - "Do you have to invent something to make it function properly?" (e.g. software)

(Typical) Three Phases

- **Phase II - Conducting a Design-based Research study**
  - Iterative micro-cycles of planning/action/analysis
    - Researchers continuously communicate **(document)** how the conjectured design *was to* function and how *it is* functioning
    - Researchers and practitioners **interact** around the evolving design
    - Contextual influences incorporated into the design
  - Selected data used to inform these micro-cycles
  - Regular references to conjectured design – which can change as the study moves forward

(Typical) Three Phases

- **Phase III - Conducting Retrospective Analysis**
  - Pool all data sources
  - Systematically work through the data focusing on the effectiveness of the conjectured design
    - "How did it function, when did it have difficulties, why did these things happen to it?"
  - Produce a "thick description" of how the study proceeded - "What did the research team learn?"
  - Core design principles are developed and refined
  - Ultimately yields a description of the "design in practice" (Collins, 1999)
  - Develop a Humble Local Theory of Instruction (Cobb, 2003)

The difference bw ER and DER

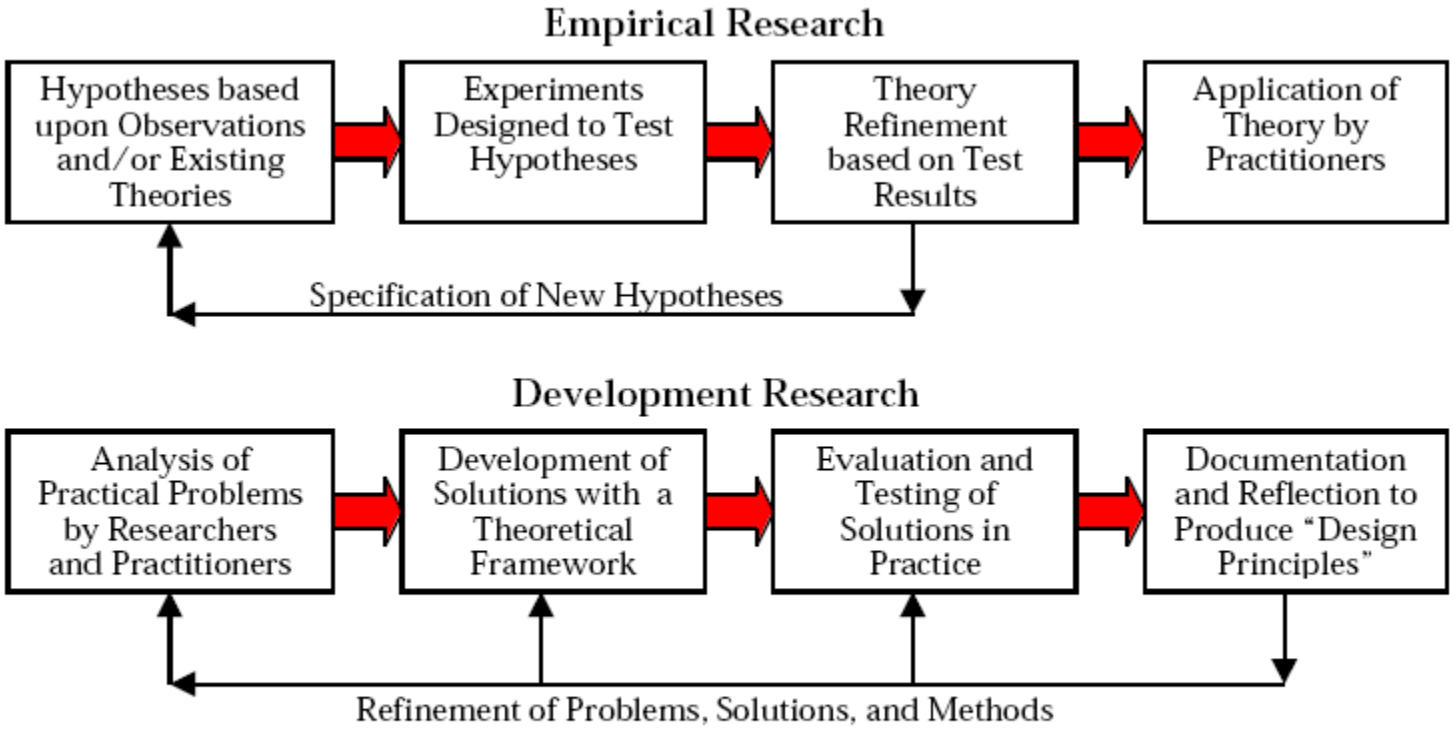


Figure 3. Empirical and development approaches to IT research.

The cycles/time of the DBR

McKenney (2001) illustrates in her study this cyclical process as follows:

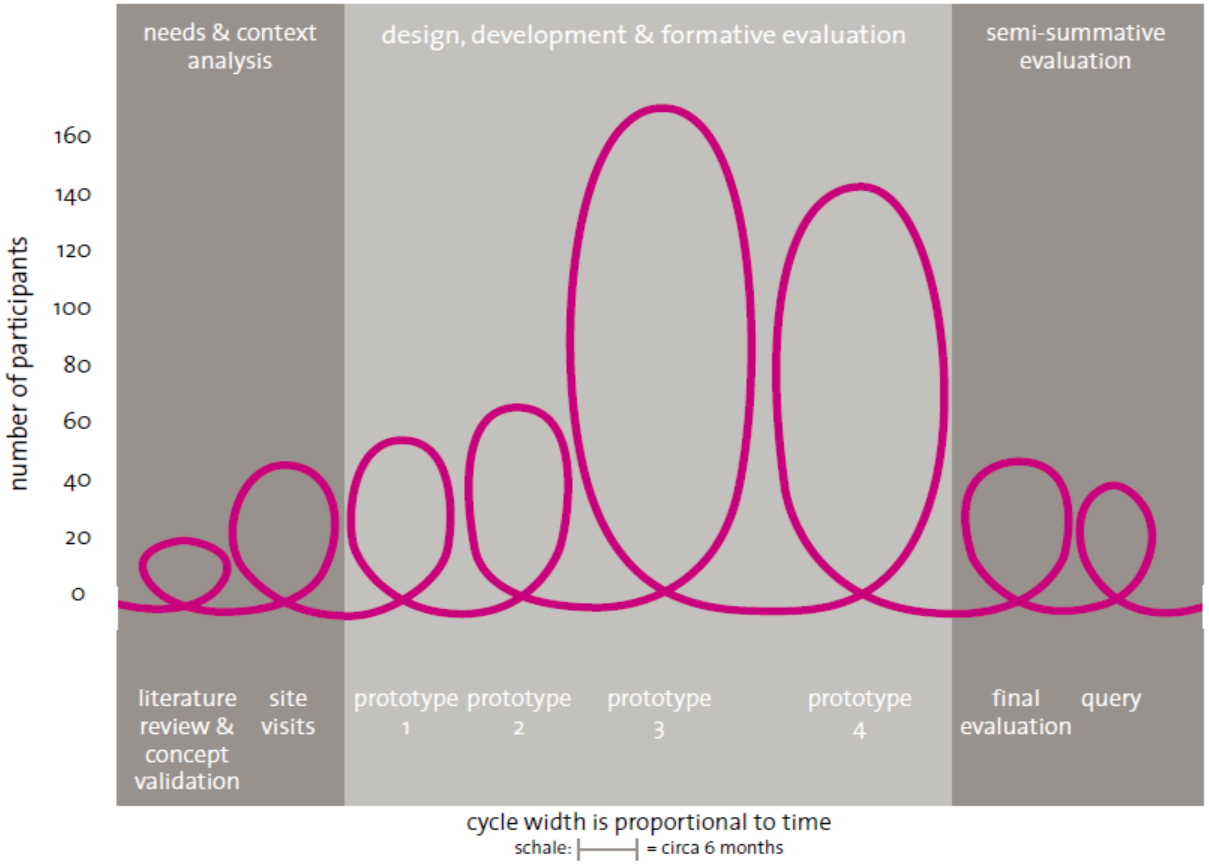


Figure 2: Display of the CASCADE-SEA study (McKenney, 2001)

Generic Design Research Model

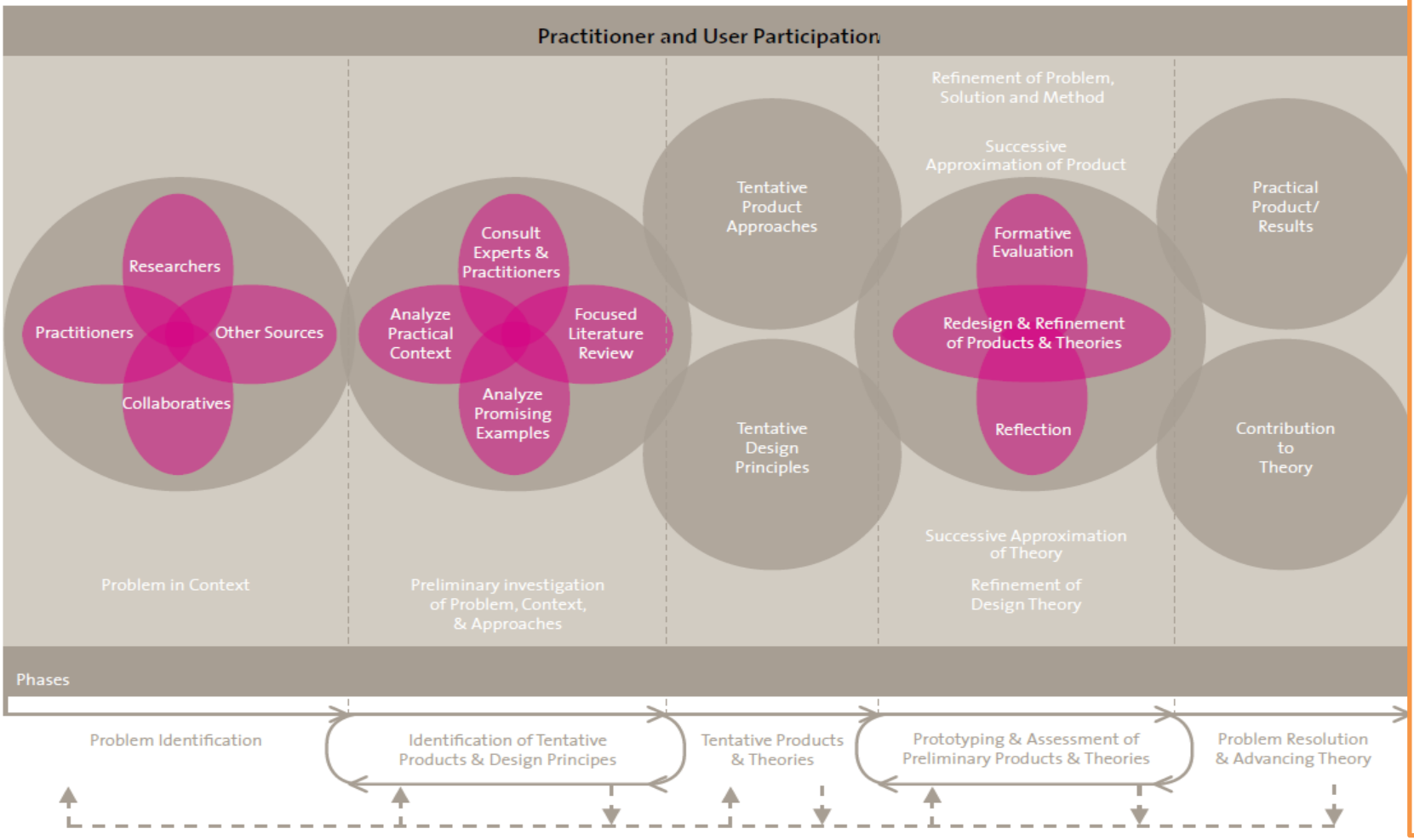
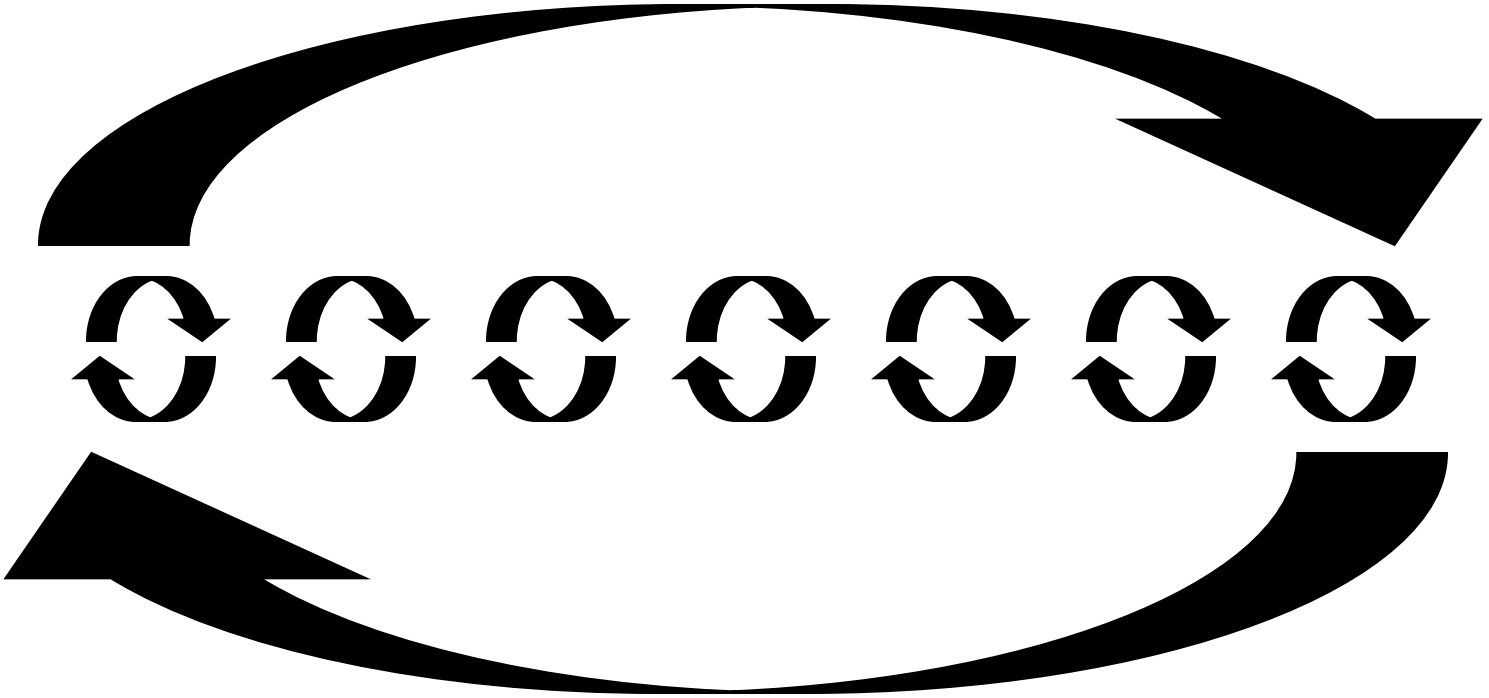


Figure 3: Generic Design Research Model (Wademan, 2005)

Timescales of design-based research



- Micro-cycles of analysis during implementation
- Macro-cycles of retrospective analysis

(from Cobb, 2001)

Examples of research projects using DBR

PhD research

Designing a Technology-Environment for Collaborative Science Learning:

How technology scaffolding learning with a par of tools in a variety of contexts?

Investigating and promoting trainee science teachers' conceptual change of the nature of science with digital dialogue games "InterLoc"

Mansour, N., Wegerif, R., Skinner, N. *et al.* Investigating and Promoting Trainee Science Teachers' Conceptual Change of the Nature of Science with Digital Dialogue Games 'InterLoc'. *Res Sci Educ* **46,** 667–684 (2016). https://doi.org/10.1007/s11165-015-9475-9

Research Design

NoS scale Pre-test

NoS lecture/workshop

ICT and InterLoc workshop

InterLoc session

F2F discussion

Descriptive/Quantitative data analysis (Pre-Post)

NoS Scale Post-test

4 Interloc Sessions

Content analysis of the Interloc discussions

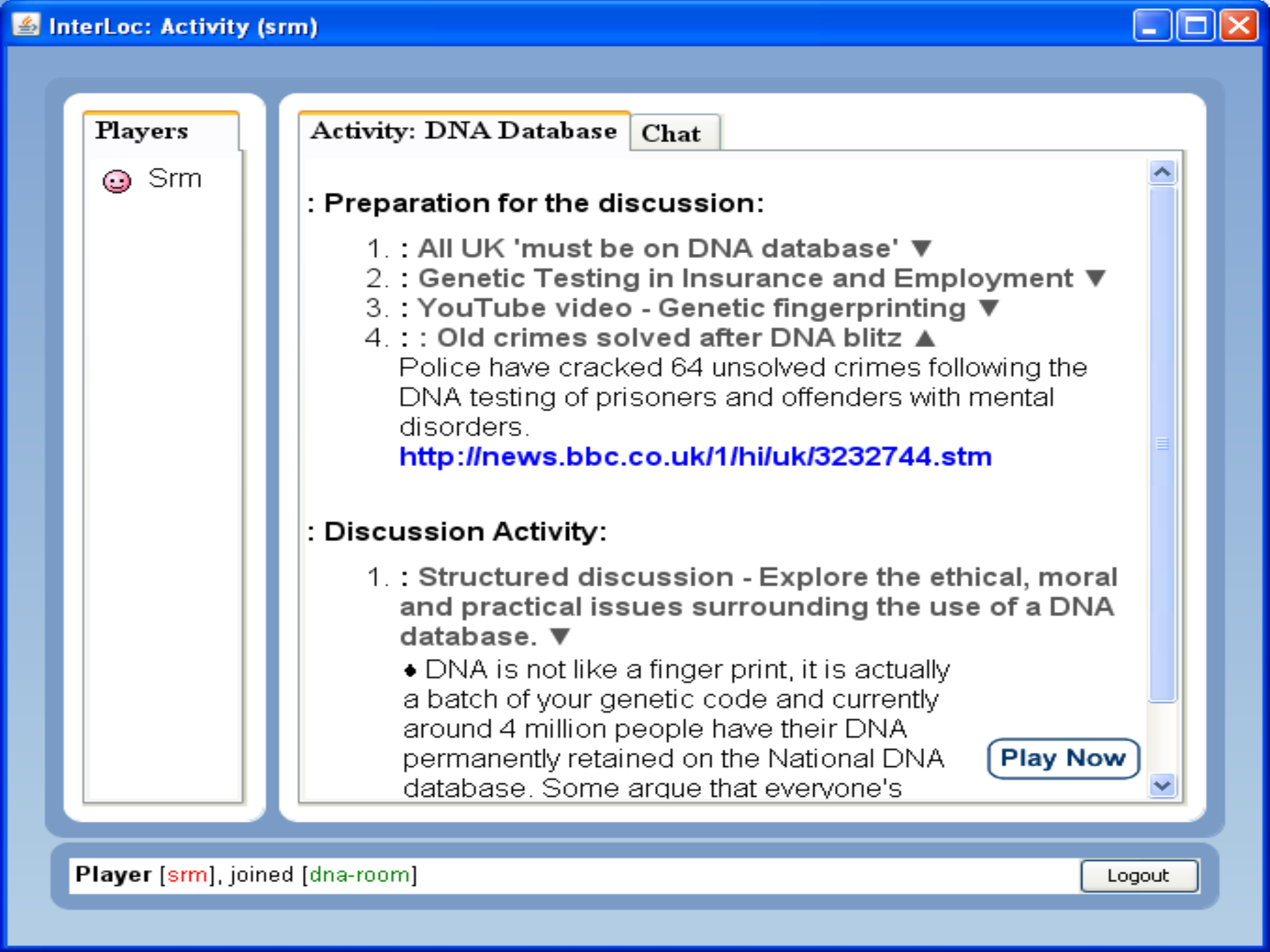
Critical Events "conceptual change evidence"

Online interviews

Critical Event Recall interviews CER

Qualitative analysis

Action chain Model (precondition-action-results/effects)


InterLoc: Activity (srm)
Players
Srm
Activity: DNA Database
Chat
: Preparation for the discussion:
1. : All UK 'must be on DNA database' ▼
2. : Genetic Testing in Insurance and Employment ▼
3. : YouTube video - Genetic fingerprinting ▼
4. : : Old crimes solved after DNA blitz ▲
Police have cracked 64 unsolved crimes following the DNA testing of prisoners and offenders with mental disorders.
http://news.bbc.co.uk/1/hi/uk/3232744.stm
: Discussion Activity:
1. : Structured discussion - Explore the ethical, moral and practical issues surrounding the use of a DNA database. ▼
♦ DNA is not like a finger print, it is actually a batch of your genetic code and currently around 4 million people have their DNA permanently retained on the National DNA database. Some argue that everyone's
Play Now
Player [srm], joined [dna-room]
Logout

Players

Mansour3

Activity: How Does Science Work? | Chat | Room Management | User Management

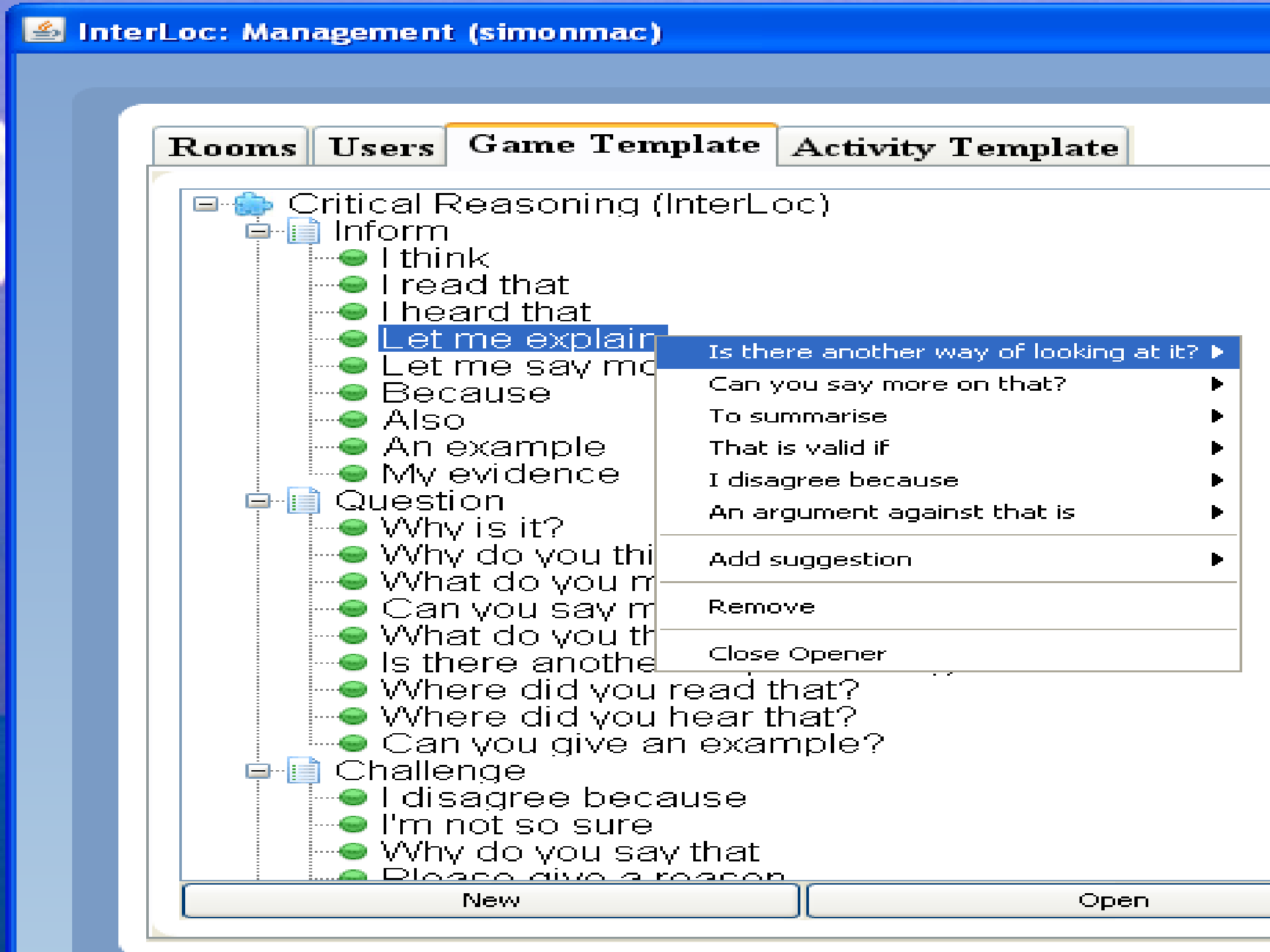
Preparation for the discussion:

1. : How Science Works in the National Curriculum ▲
   Read the sections of the national curriculum website which explain what pupils need to learn about the key concepts and processes of science. Write a summary of about 200 words.
   Link: **http://curriculum.qca.org.uk/**
2. : Purposes of Science Education ▲
   Description: Read the Beyond 2000 paper and use it, along with your own ideas, to make a bullet point list of ideas about what science education is for. Write about 200 words about the ways in which the national curriculum does or does not (!) align with these purposes.
   Link: **http://education.exeter.ac.uk/download.php?id=4980**
3. : Nature of Science ▲
   Read the paper, "Philosophy of Science: An Overview for Educators" (Machamer 1998) and use it, along with your own ideas, to make a bullet point list of what characterises science. What distinguishes it from e.g. astrology or mathematics? Write about 200 words about the ways in which the national curriculum reflects your characterisation of science, or is in conflict with it.
   Link: **http://education.exeter.ac.uk/download.php?id=7401**

Discussion Activity:

1. ▼
   ♦ "The national curriculum for Science as currently defined is totally inadequate to meet the purposes of science education and gives a false impression of the nature of science." Discuss!

Play Now


InterLoc: Management (simonmac)
Rooms
Users
Game Template
Activity Template
Critical Reasoning (InterLoc)
Inform
I think
I read that
I heard that
Let me explain
Let me say mo
Because
Also
An example
My evidence
Question
Why is it?
Why do you thi
What do you m
Can you say m
What do you th
Is there anothe
Where did you read that?
Where did you hear that?
Can you give an example?
Challenge
I disagree because
I'm not so sure
Why do you say that
Is there another way of looking at it?
Can you say more on that?
To summarise
That is valid if
I disagree because
An argument against that is
Add suggestion
Remove
Close Opener
New
Open

Dialogue Area (george)

"The national curriculum for Science as currently defined is totally inadequate to meet the purposes of science education and gives a false impression of the nature of science." Discuss!

wilky -

I think if the NC was not in place, and teachers could teach what they wanted, then a false impression of the nature of science is a likely outcome. (Reply)

george -

I agree because there would be no standard, however the exam specifications would act as a good guide. (Reply)

wilky -

I disagree because the exam boards don't have any practical element (Reply)

john2

Also i think a lot of people would just get left behind (Reply)

george -

I'm not so sure ,there is a coursework element to the specification they give, which would be a practical investigation. (Reply)

emma -

Isn't it the case that there is also a case study coursework too in which the pupils have to research (independently) current issues in science and attempt to understand the processes and methods behind related experiments too? Although, obviously, this isn't a substitute for actually doing something, but it is another insight into process. (Reply)

john2 -

Let me explain I believe the only coursework done in GCSE science now is done in class, in the format of an experiment, which they then have to do a short exam on (Reply)

emma

I disagree because the school I worked in always had case study bits of coursework too where the pupils had to do independent research. (Reply)

Choose Opener ▼

- Is there another way of looking at it?
- Why do you think that?
- Why is it?
- Can you say more on that?
- I disagree because
- Is there any evidence that
- Why do you say that
- Isn't it the case that
- More ▸

Send

Cancel

Choose Opener

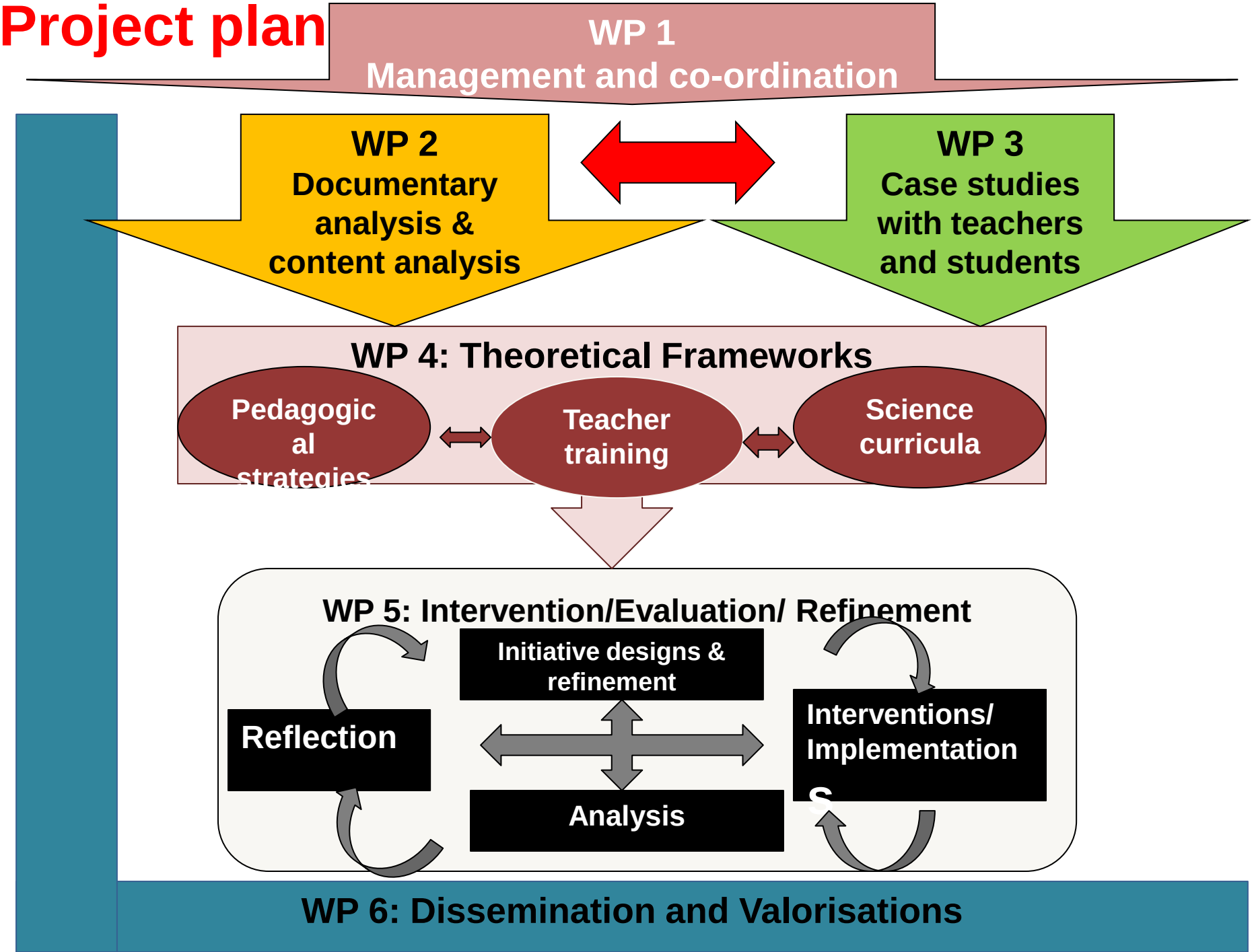
Send

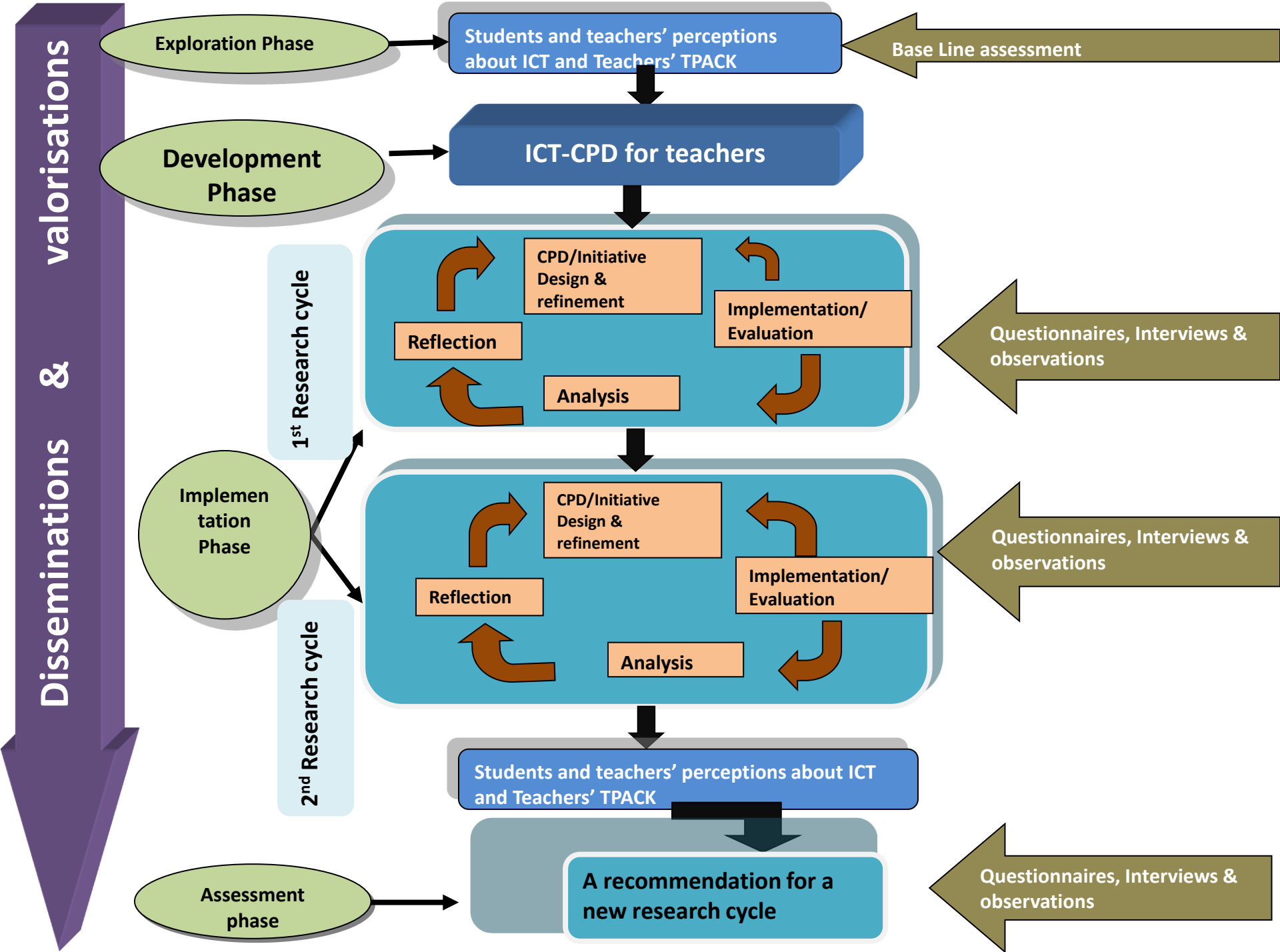
Contribute

No New Messages

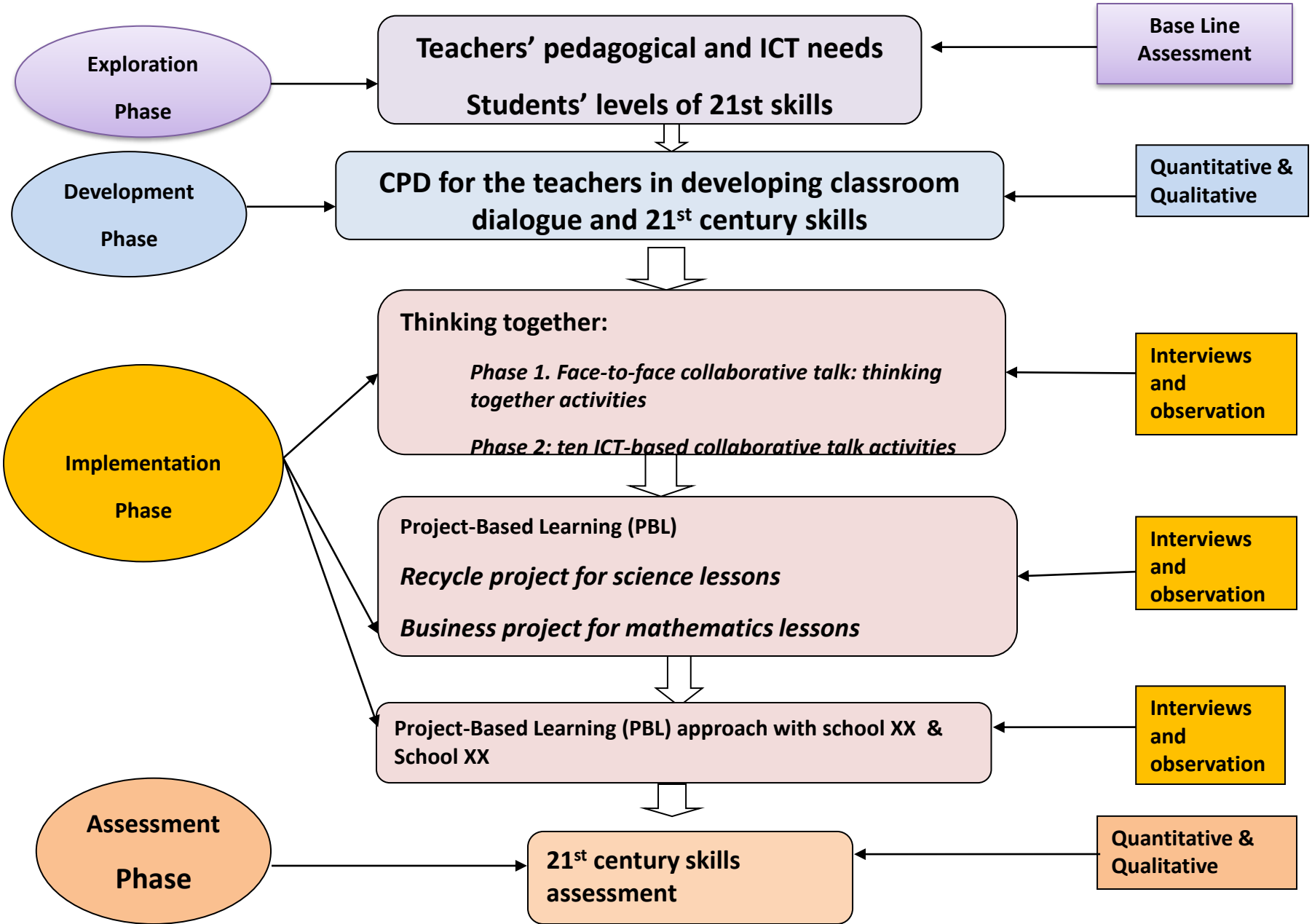
Save Dialogue as HTML

Project plan




Disseminations & valorisations
Exploration Phase
Students and teachers' perceptions about ICT and Teachers' TPACK
Base Line assessment
Development Phase
ICT-CPD for teachers
1st Research cycle
CPD/Initiative Design & refinement
Implementation/ Evaluation
Analysis
Reflection
Questionnaires, Interviews & observations
Implemen tation Phase
2nd Research cycle
CPD/Initiative Design & refinement
Implementation/ Evaluation
Analysis
Reflection
Questionnaires, Interviews & observations
Students and teachers' perceptions about ICT and Teachers' TPACK
Assessment phase
A recommendation for a new research cycle
Questionnaires, Interviews & observations

Research Design



Reflections

- In groups discuss:

- How do you think DBR fit your research plan?
- What is your concerns about using DBR?
- What are the challenges of using DBR as a research design for a PhD project?

Back to Theory vs. Practice

Principles of Design Based Research

- Designing learning environments intertwined with developing theories (proto-theories)
- Cycles of design, enactment, analysis & redesign. Respond to emergent features
- Must lead to sharable theories (plausible causal accounts)
- Must account for how designs function in authentic settings (document success, failure and interactions)
- Relies on methods that can document and connect processes of enactments to outcomes of interest

To summarise ……

Authors may vary in the details of how they picture design research, but they all agree that design research comprises of a number of stages or phases:

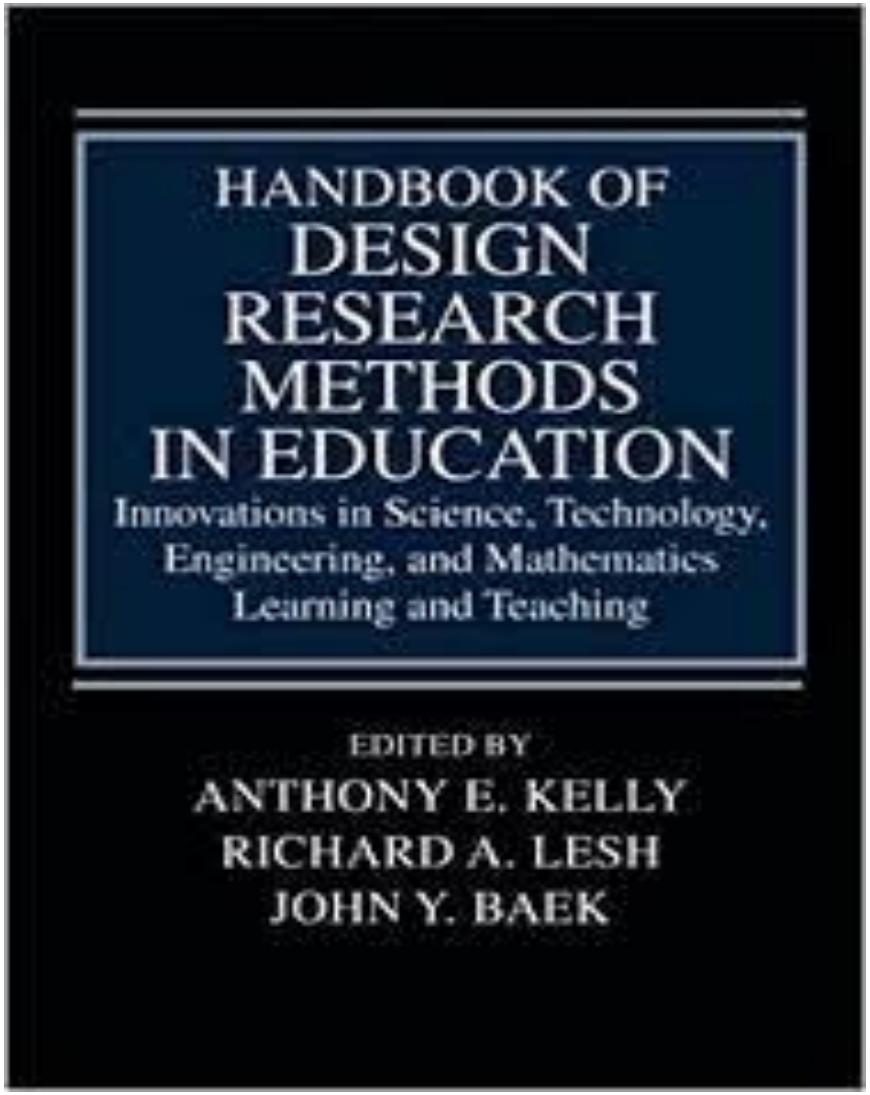
- **Preliminary research***: needs and context analysis, review of literature, development of a* conceptual or theoretical framework for the study
- **Prototyping phase***: iterative design phase consisting of iterations, each being a microcycle* of research with formative evaluation as the most important research activity aimed at improving and refining the intervention
- **Assessment phase***: (semi-) summative evaluation to conclude whether the solution or* intervention meets the pre-determined specifications. As also this phase often results in recommendations for improvement of the intervention, we call this **phase semisummative**.

To summarise .....

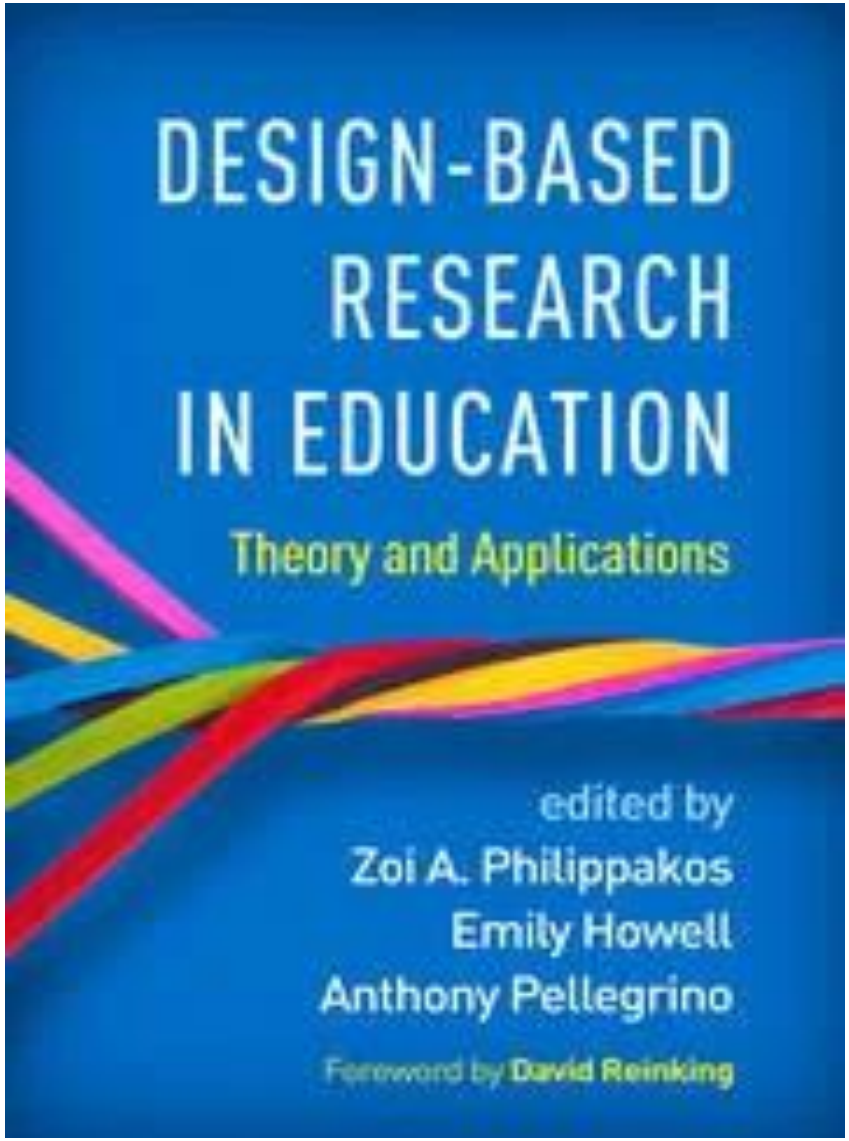
- Authors about design research also agree a number of characteristics of this type of research. These are summarized by Van den Akker et al. (2006: 5):
- **Interventionist***: the research aims at designing an intervention in a real world setting;*
- **Iterative***: the research incorporates cycles of analysis, design and development,* evaluation, and revision;
- **Involvement of practitioners***: active participation of practitioners in the various stages* and activities of the research
- **Process oriented***: the focus is on understanding and improving interventions (a black* box model of input – output measurement is avoided);
- **Utility oriented***: the merit of a design is measured, in part by its practicality for users in* real contexts; and
- **Theory oriented***: the design is (at least partly) based on a conceptual framework and* upon theoretical propositions, whilst the systematic evaluation of consecutive prototypes of the intervention contributes to theory building.

An Introduction to Educational Design Research

Proceedings of the seminar conducted at the East China Normal University, Shanghai (PR China), November 23-26, 2007



Handbook of Design Research Methods in Education: Innovations in Science, Technology, Engineering, and Mathematics Learning and Teaching by Anthony E. Kelly (Editor), Richard A. Lesh (Editor), John Y. Baek (Editor) Routledge; 1st edition (June 21, 2008)



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references

- O'Neill, K. (2012). Designs that fly: what the history of aeronautics tells us about the future of design-based research in education, International Journal of Research & Method in Education, 35:2, 119-140.