O impacto das TICs na educação
El impacto de las TICs en la educación
The Impact of ICT in education

"Assessing Impact of ICT on the quality of education"

Patricio Rodríguez
Miguel Nussbaum

Department of Computer Science
College of Engineering
Pontificia Universidad Católica de Chile

28.04.2010

Objectives

- To understand some of the weakness of the design, implementation and evaluation of ICT in educational settings
- Propose a conceptual model to create ICT for education programs
- Discuss applications for public policies

ICT in education

History

Significant evaluation studies

Uses of ICT on education &
Research topics

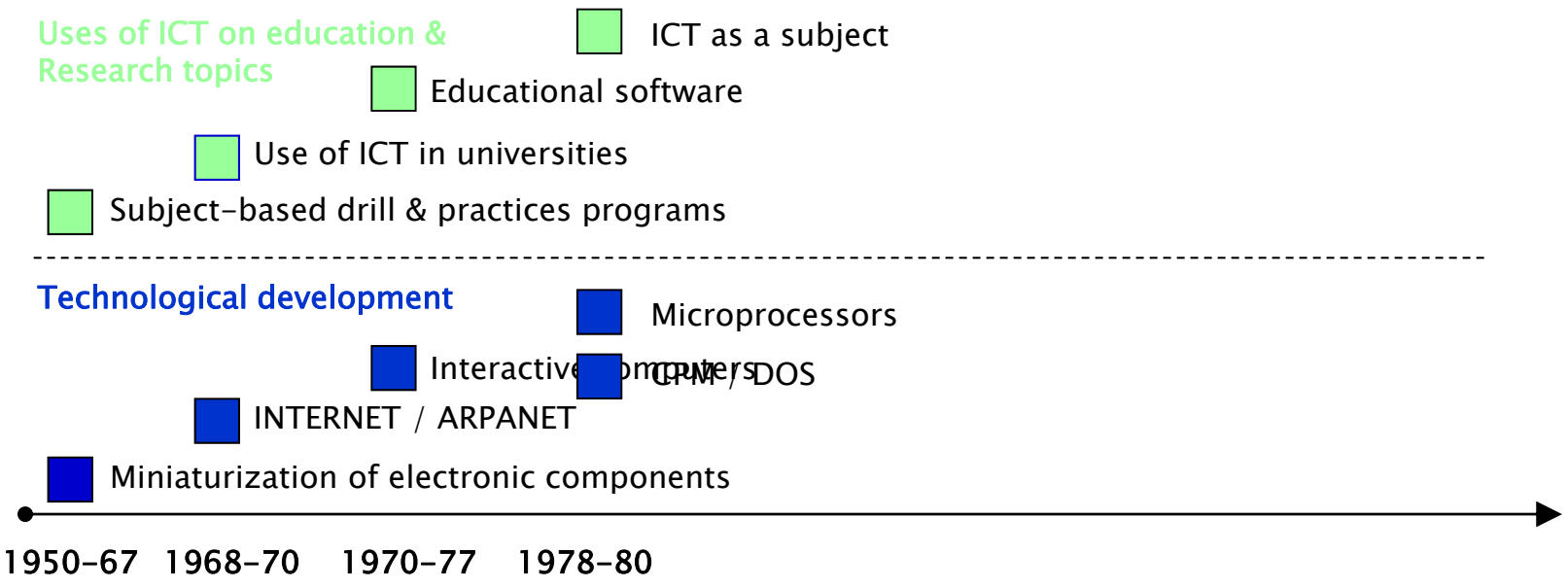
Technological development

Years

ICT in education

History

Significant evaluation studies



ICT in education

History

Significant evaluation studies

Uses of ICT on education &
Research topics

- Widespread use of computers in schools
- LOGO
- Spreadsheets / word processors software

Technological development

- World wide web
- Windows
- IBM-PC / Apple Macintosh

1980-90

ICT in education

History

Significant evaluation studies

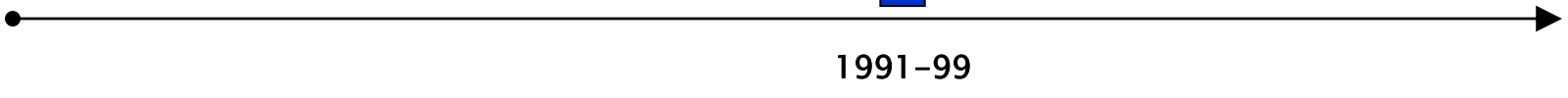
- SITES M1
- ImpaCT2
- ImpaCT

Uses of ICT on education &
Research topics

- Theories about educational change
- Need of resources for teaching with ICT
- Widespread use of ICT in schools

Technological development

- Personal Digital Assistants
- Interactive whiteboards
- Classroom Projectors
- Laptop computers



ICT in education

History

Significant evaluation studies

Silicon Valley vs Silicon Glen

SITES M2

Uses of ICT on education &
Research topics

On-line courses and assessment

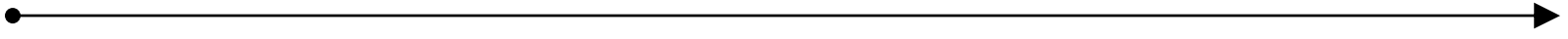
Conflict between productivity and educational software

Technological development

Wireless network massification

Learning Virtual Environments

Internet massification



2000-04

ICT in education

History

Significant evaluation studies

Impact Report (European Schoolnet)

Uses of ICT on education &
Research topics

Impact on standardized tests

Digital Literacy

Technological development

Web 2.0

2004-07

ICT in education

History

Significant evaluation studies

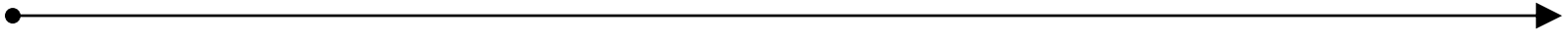
- Evaluation of "Computadores para educar" (Colombia)
- Evaluation of "Enlaces" network (Chile)
- Effectiveness of Reading and Mathematics Software Products II (USA)
- Effectiveness of Reading and Mathematics Software Products I (USA)
- SITES 2006

Uses of ICT on education & Research topics

- 21st Century skills
- CSCL
- 1:1

Technological development

- Kindle, Ipad
- OLPC, Netbooks
- YouTube, Facebook, Twitter



2008-10

What affects the impact of ICT on education?

What we know

- ICT was not designed for educational purposes
- Technology is put before pedagogy
- Existing educational research was not applied to ICT programs
- ICT generally implemented without valid theoretical support
- ICT competes with the needs of the system, measured by standardized tests
- Lack of adequate ICT monitoring initiativies, to learn from experience

Evaluation of the impact

What we know

- No accepted standard methodologies for measuring the impact

- Evaluation weakness are:
  - What to measure
  - What to measure with
  - How to measure

Evaluation of the impact

What we know

- **What to measure**:
  - Identifying the effects of ICTs
  - Identifying how the ICT design and its curricular implementation affect students' attainment
  - Teachers' pedagogical approaches

Evaluation of the impact

What we know

- **What to measure with**:
  - Assessment instruments don't match the defined aims
  - The instruments that measure educational results are rarely sufficiently investigated, as far as reliability and validity

Evaluation of the impact

What we know

- How to measure:
  - It is difficult to isolate the role technology plays in experimental studies carried out in real educational settings
  - There are substantial differences between the design and actual implementation of ICTs in education
  - Lack of explanation regarding results
  - Relevance of findings

Conceptual model

Concepts & background

- Efficacy, effectiveness, efficiency
- Formative and summative studies
- Investigation methods: “Design research”
- ICT for education program
- Experimental design

Conceptual model

Concepts & background: 3E

- **Efficacy** : when in controlled environments, technology is evaluated to determine if it *can* improve students' results

- **Effectiveness**: when in real educational settings, technology is evaluated to determine if better results are *really* obtained

- **Efficiency** : considers program costs to effectiveness, measuring its practical applicability and replicability

Conceptual model

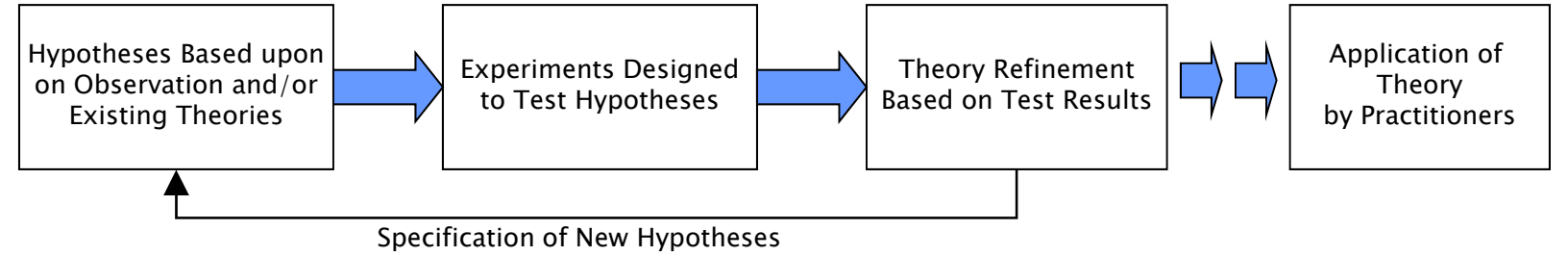
Background: evaluation studies

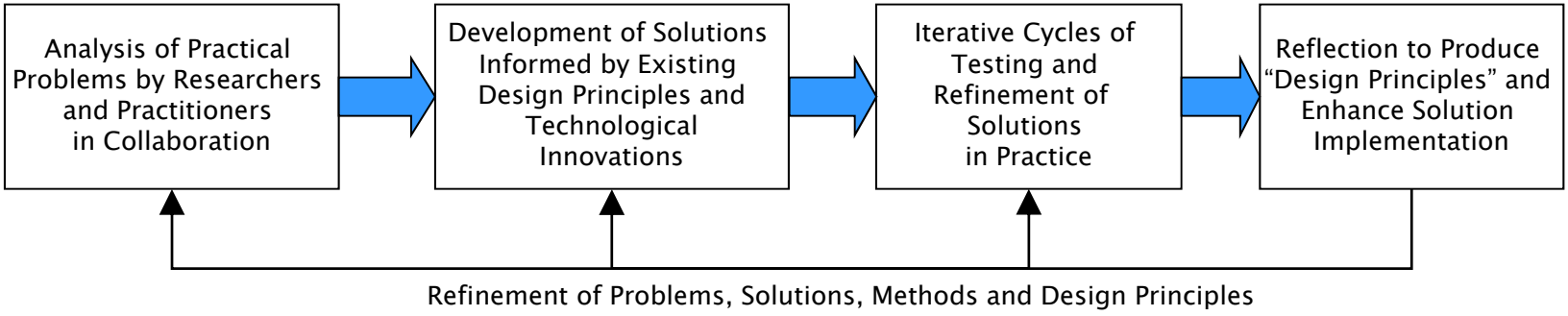
- **Formative** studies are carried out to improve learning environments *while* the program is being developed

- **Summative** studies aim to show its impact once it is completed

Conceptual model

Background: design research





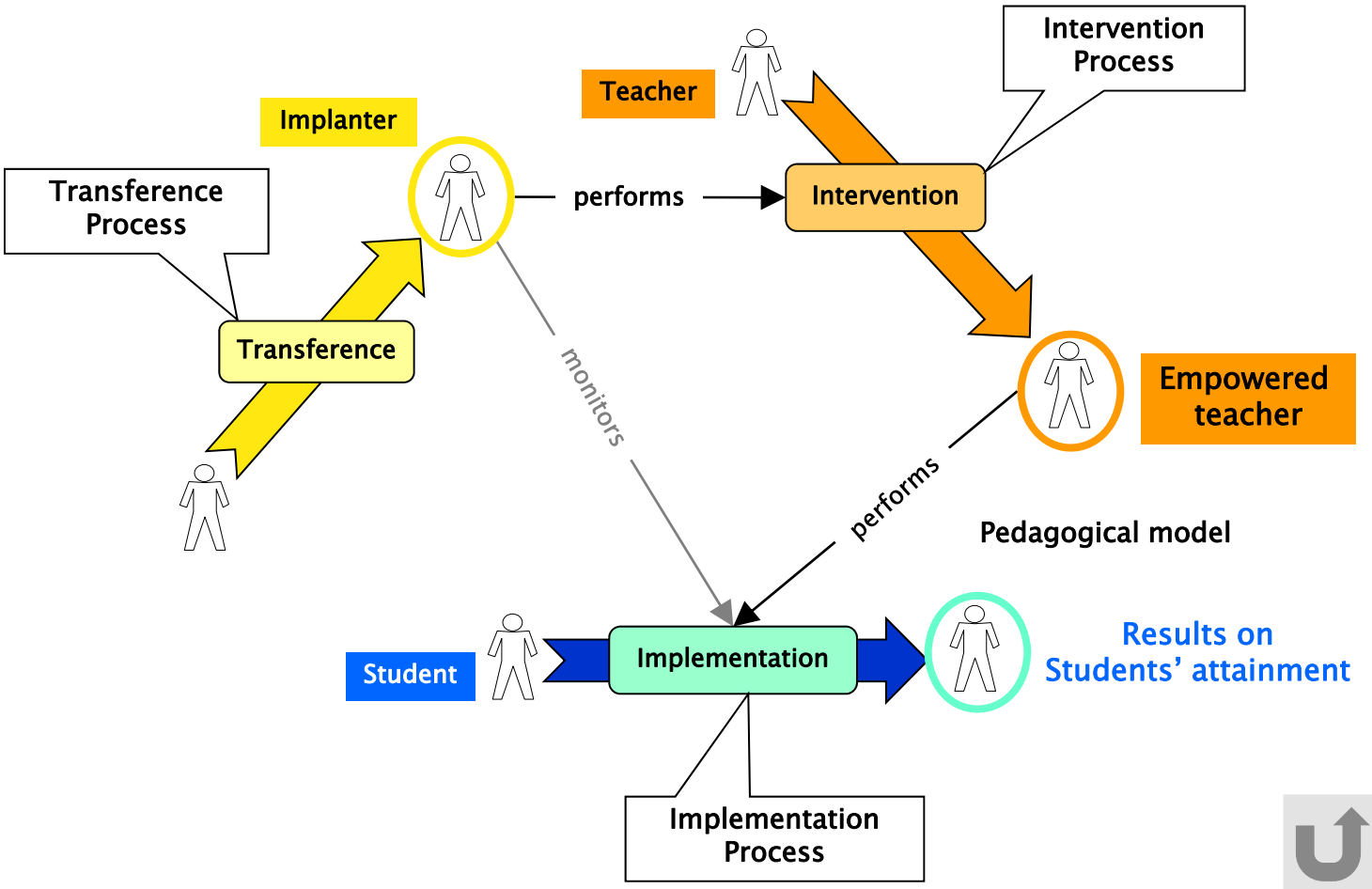
Conceptual model

Background: ICT4E program

- ICT for Education (ICT4E) Program:
  - Pedagogical Model (what is installed)
  - Intervention (how it is installed and monitored)
  - Transference (training for intervention)

Conceptual model

Background: ICT4E program



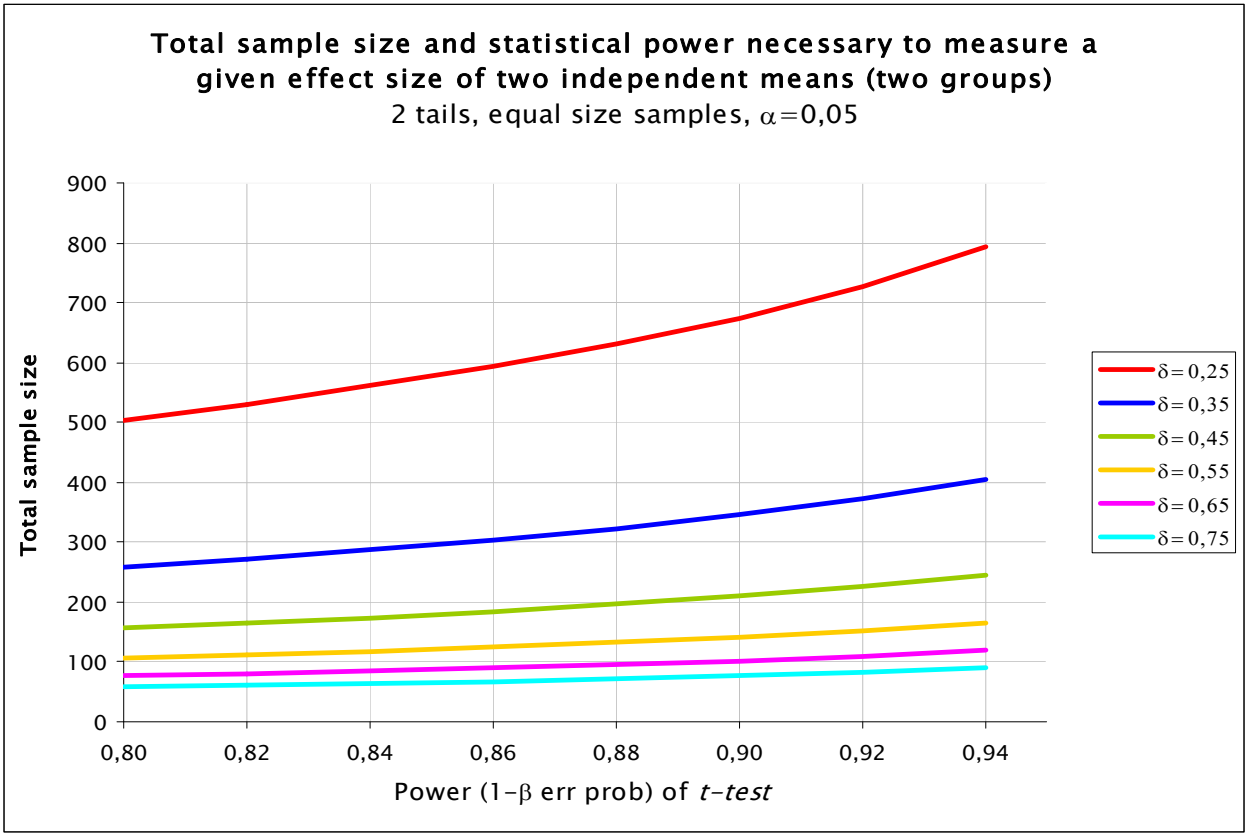
Conceptual model

Background: designing experiments

- To find rigorous evidence (BEE, WWC) of the impact of technology on students' attainment, key are:
  - Experimental design
  - Sample size
  - Interpretation of results
- Effect size and statistical significance must be interpreted together (Fan, 2001)
- When **effect size** (δ) is measured, **type I** (α) and **type II** (β) errors have to be controlled
  - These 3 elements are related with the sample size:
    - $\alpha = 0.05$
    - $1 - \beta \geq 0.8$ (Fox & Mathers, 1997)
    - $\delta \geq 0.25$ (Agodini et al. 2003).
  - Effect size diminishes with larger sample sizes (Slavin & Smith, 2009).

Conceptual model

Background: sample size

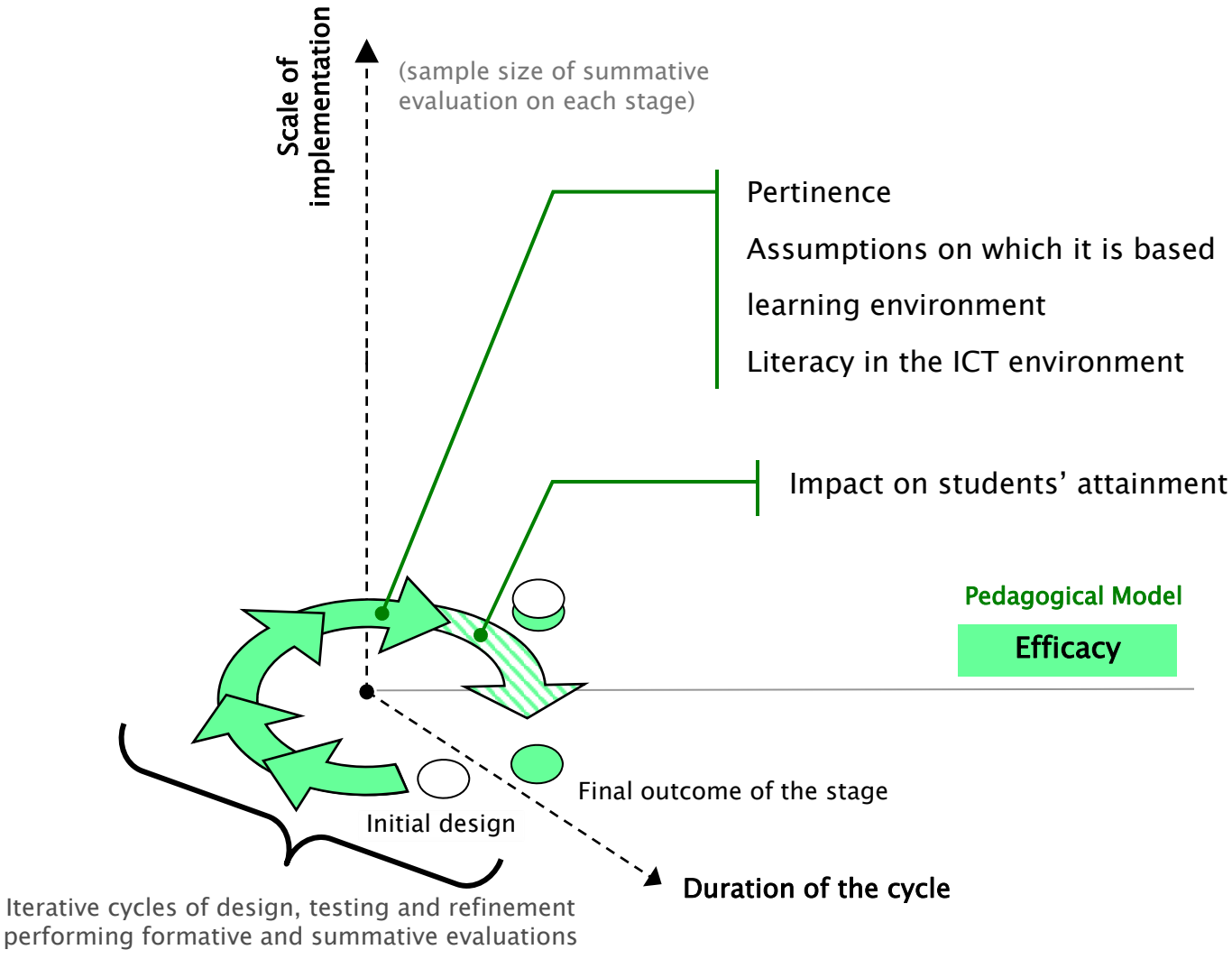


Conceptual model

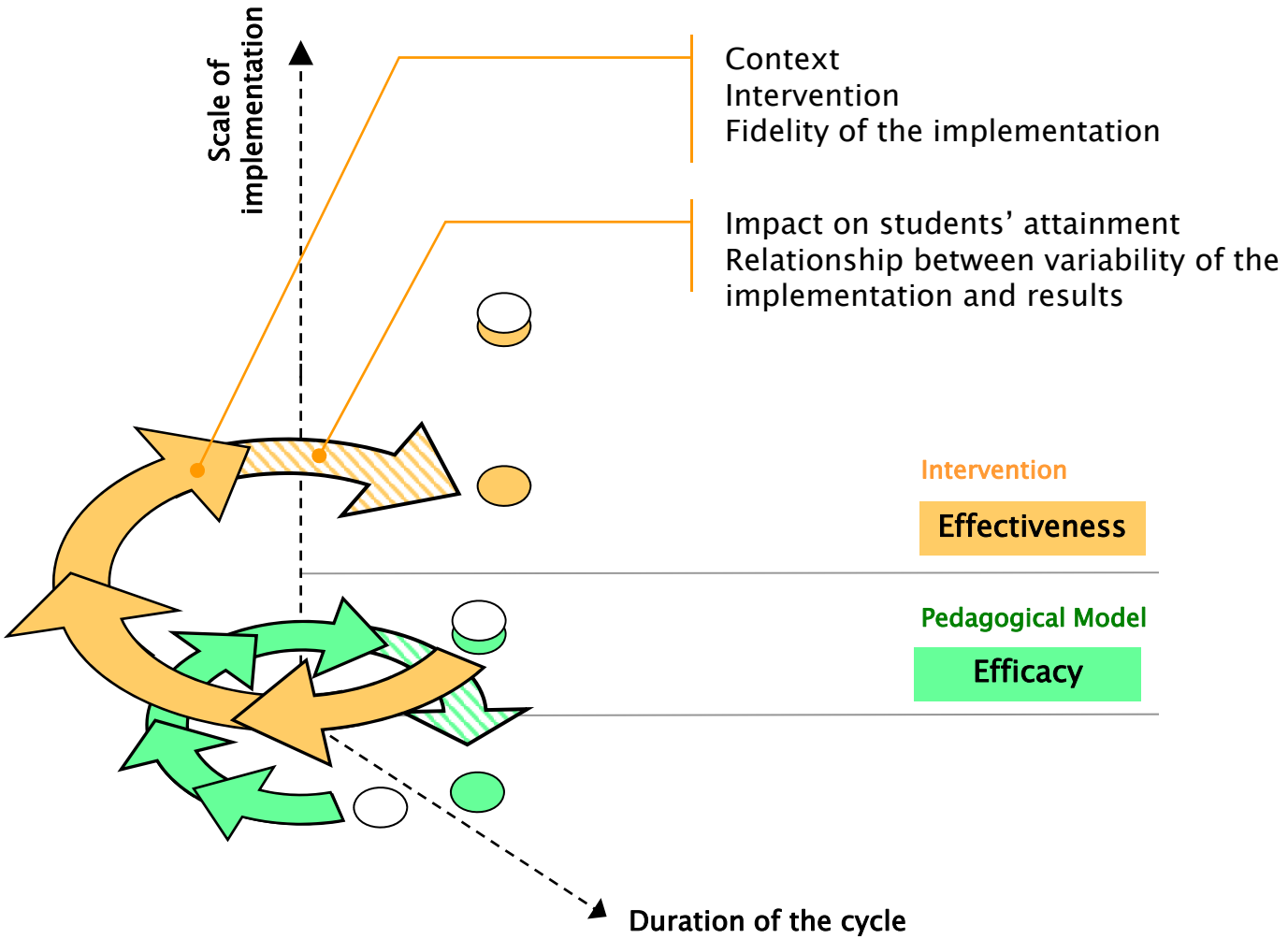
- Decomposes the problem of designing, implementing and evaluating ICT4E programs in stages:
  - **Efficacy**: studies the impact in laboratory and real educational environments focusing on the pedagogical model
  - **Effectiveness**: studies the impact in real educational environments focusing on the pedagogical model and intervention
  - **Efficiency**: studies the impact in real educational environments focusing on the pedagogical model, intervention, transference and costs of the solution.

- Ensure the effectiveness of the ICT4E programs before performing expensive summative evaluations.

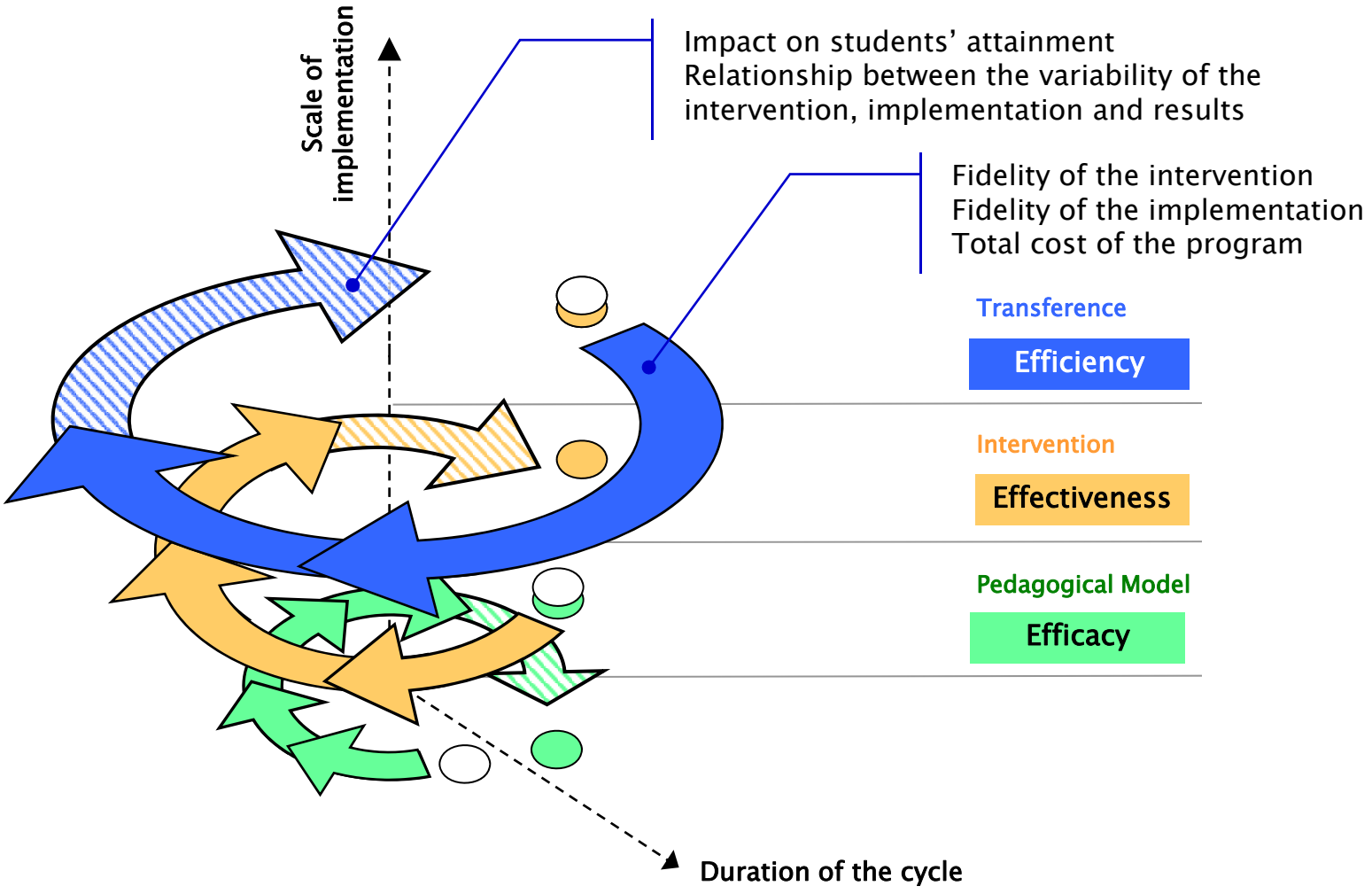
Conceptual model



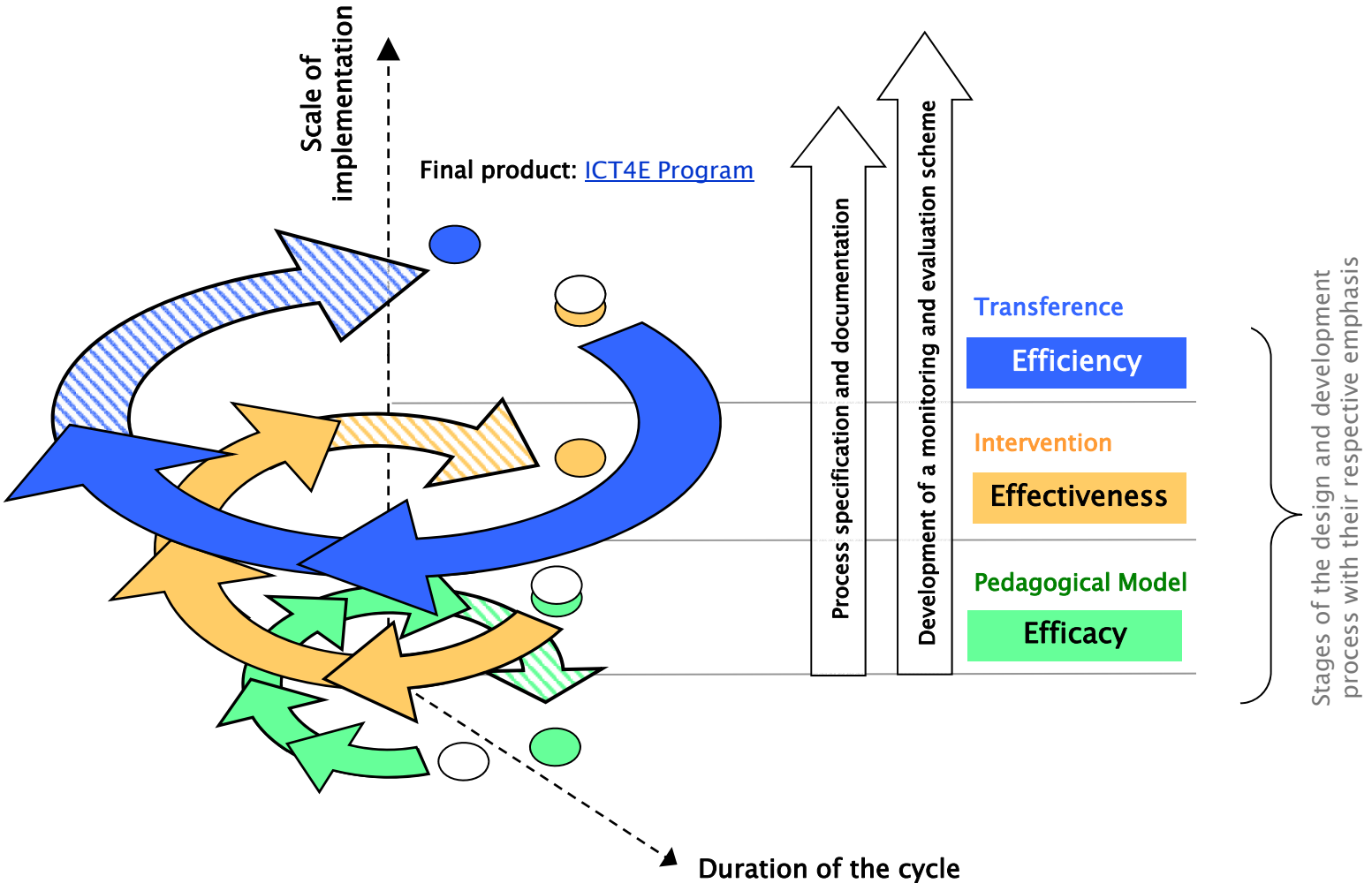
Conceptual model



Conceptual model



Conceptual model



Conceptual model

An example

Collaborative activities without technology

Primary education
(1st and 2nd grades)

Collaborative learning
(Dillenbourg, 1999)

Pedagogical Model

Efficacy

1 school

weeks

Duration of the cycle

Conceptual model

An example

Collaborative activities with technology

Primary education
(1st and 2nd grades)

Mobile Computer supported Collaborative learning
(Zurita & Nussbaum, 2007)

Pedagogical Model

Efficacy

1 school

weeks

Duration of the cycle

Conceptual model

An example

Collaborative activities without technology

Conceptual model

An example

Collaborative activities with technology

Conceptual model

An example

2004

Secondary education
(9th and 10th grades)

Intervention

Effectiveness

5 schools

months

Duration of the cycle

Conceptual model

An example

2005-2006

Secondary education
(9th and 10th grades)

Intervention

Effectiveness

5 schools

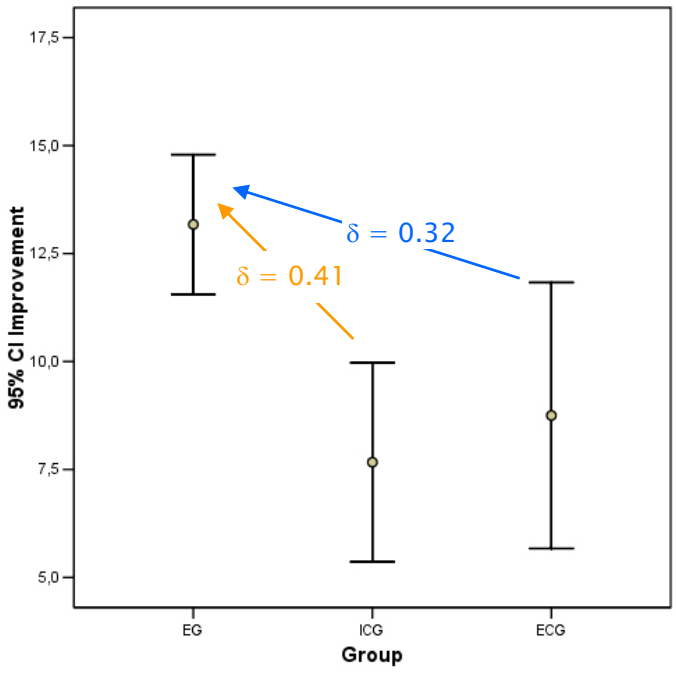
months

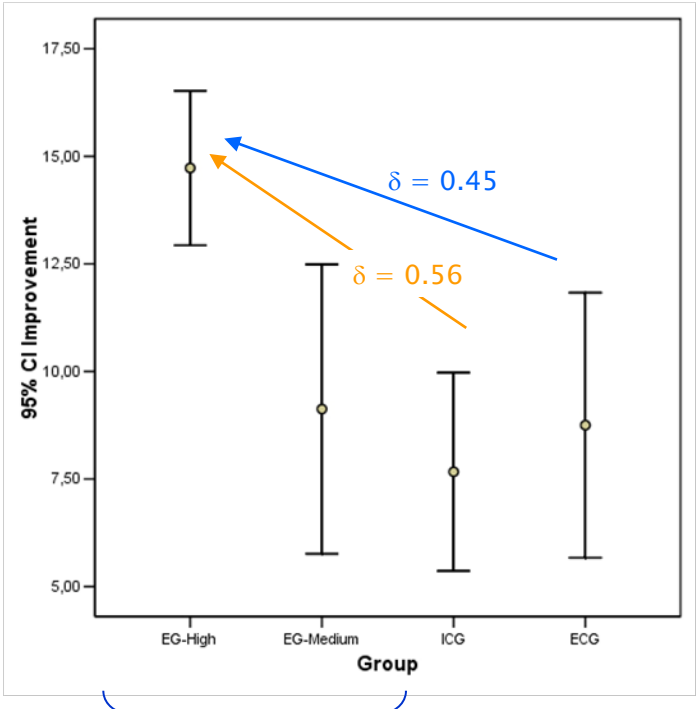
Duration of the cycle

Conceptual model

An example

Students' attainment in Physics (10th grade) 2005-2006





teacher adoption level

(Rodríguez et al. 2010)

Conceptual model

An example

2007

Primary and secondary education

Transference

Efficiency

30 schools

years

Duration of the cycle

Conceptual model

An example

2008

Primary and secondary education

Transference

Efficiency

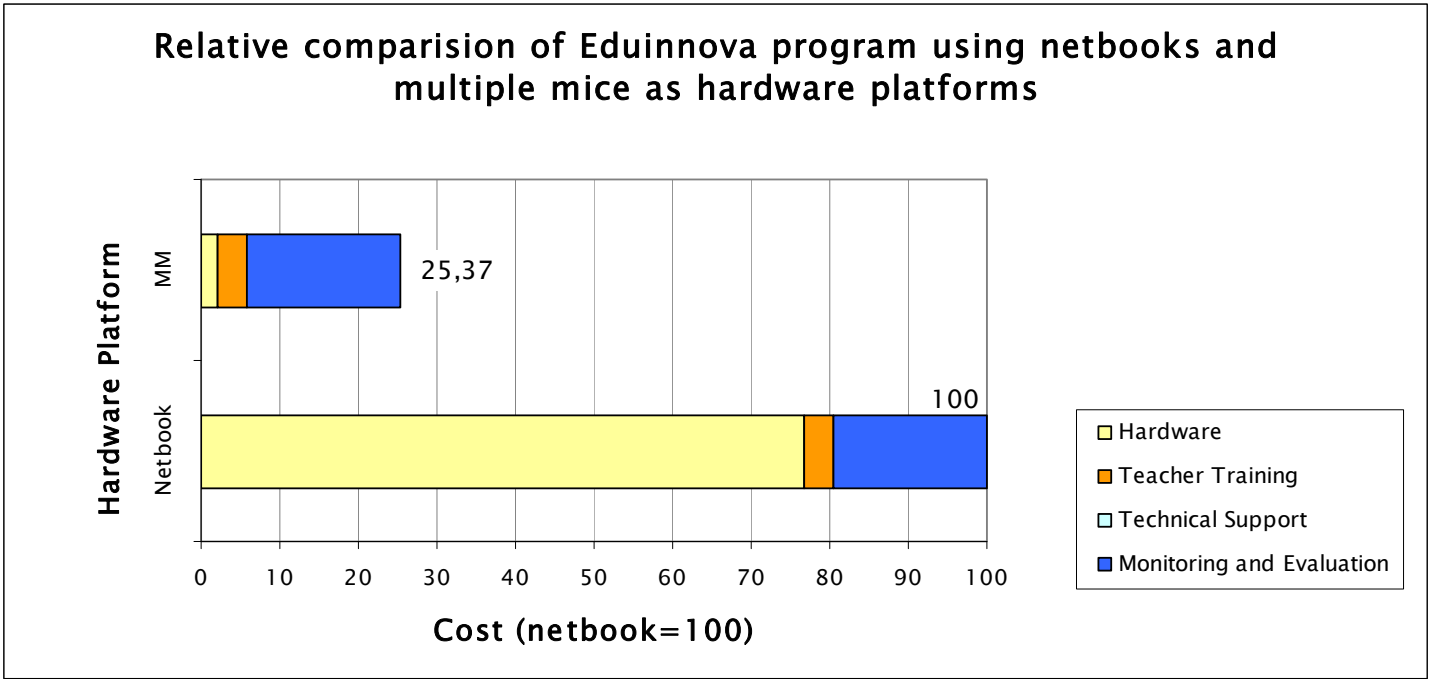
30 schools

years

Duration of the cycle

Conceptual model

An example

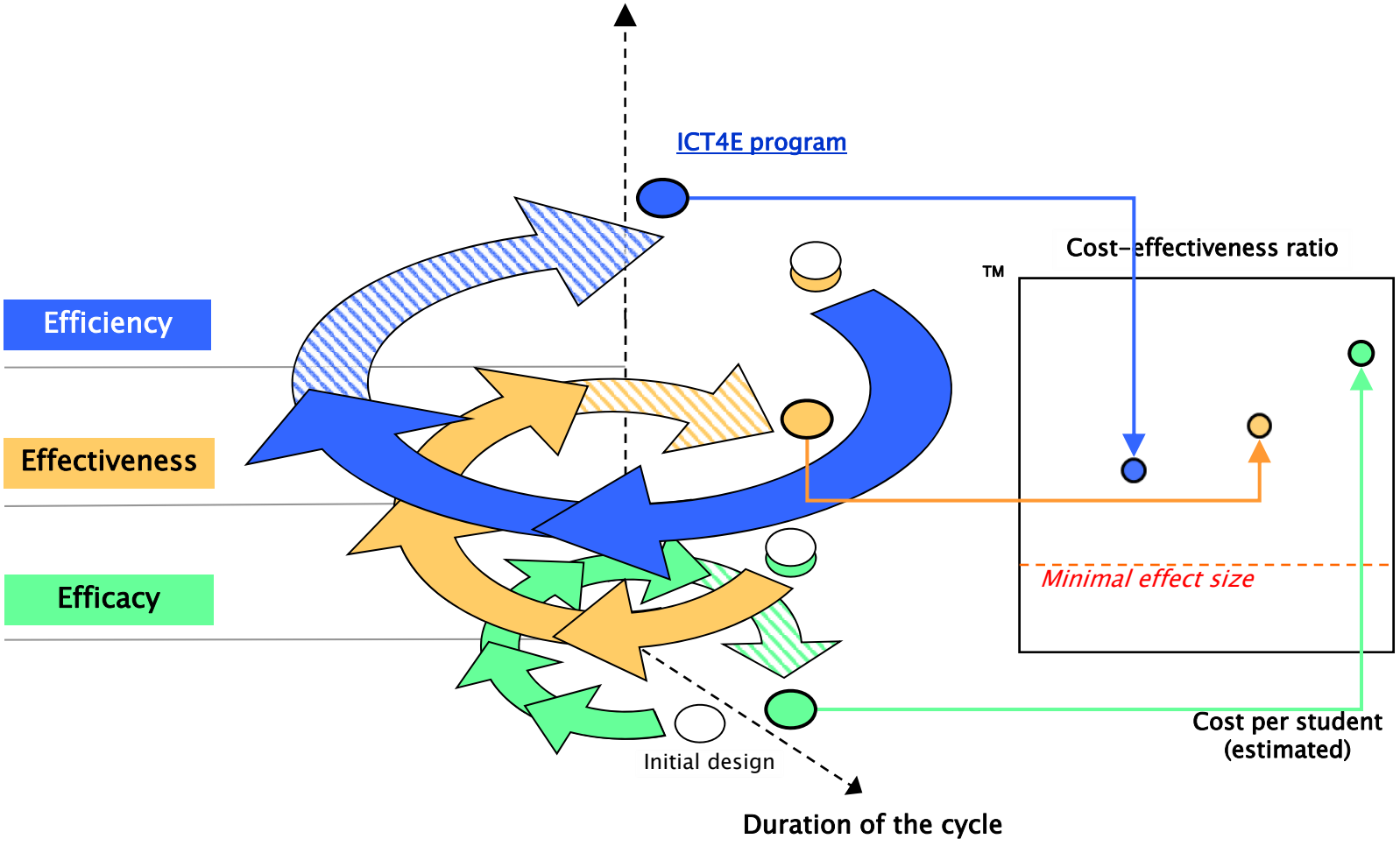


δ MM 0.52 – 0.66

Applications

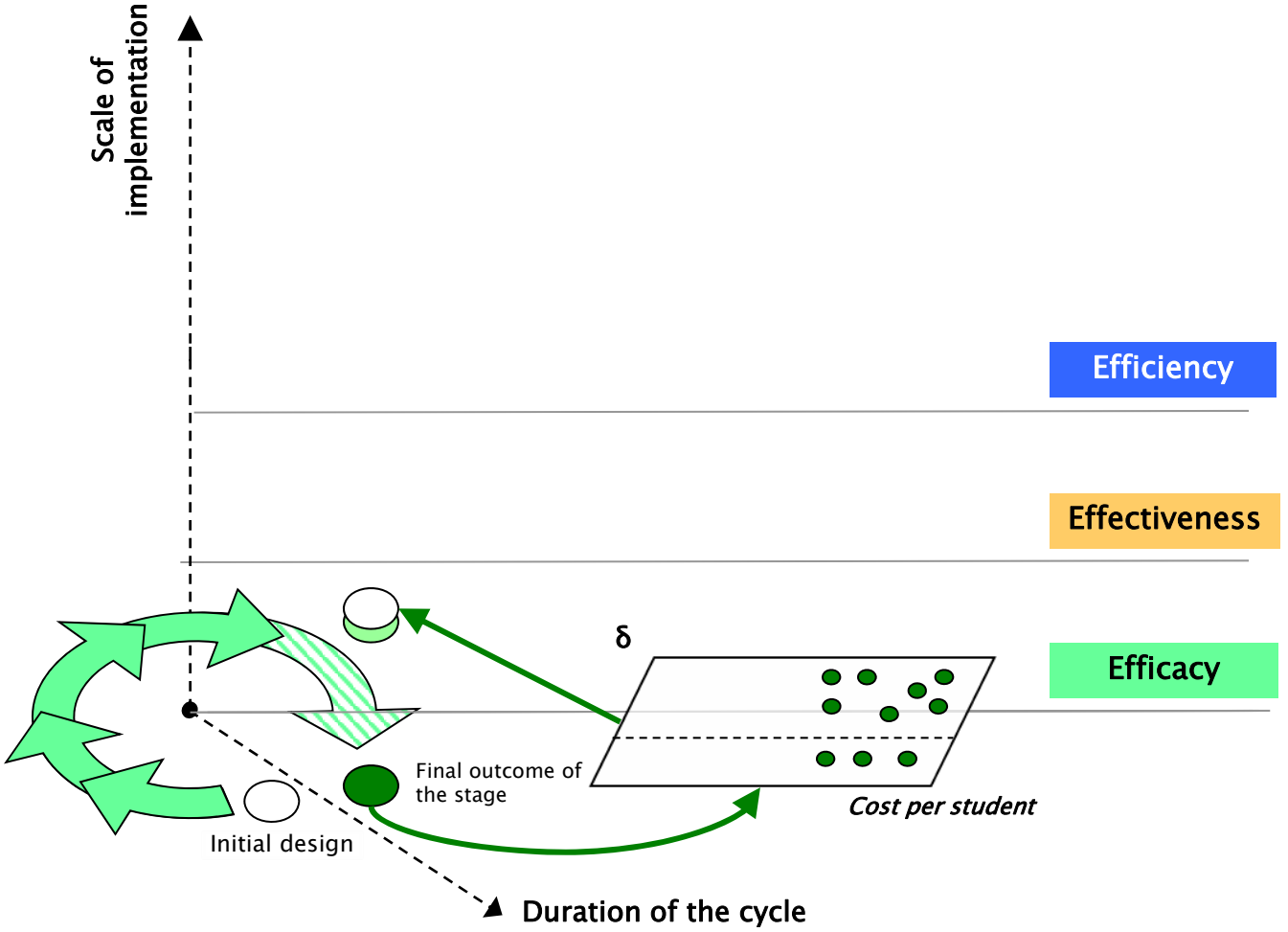
Applications

Incorporating cost-effectiveness to design



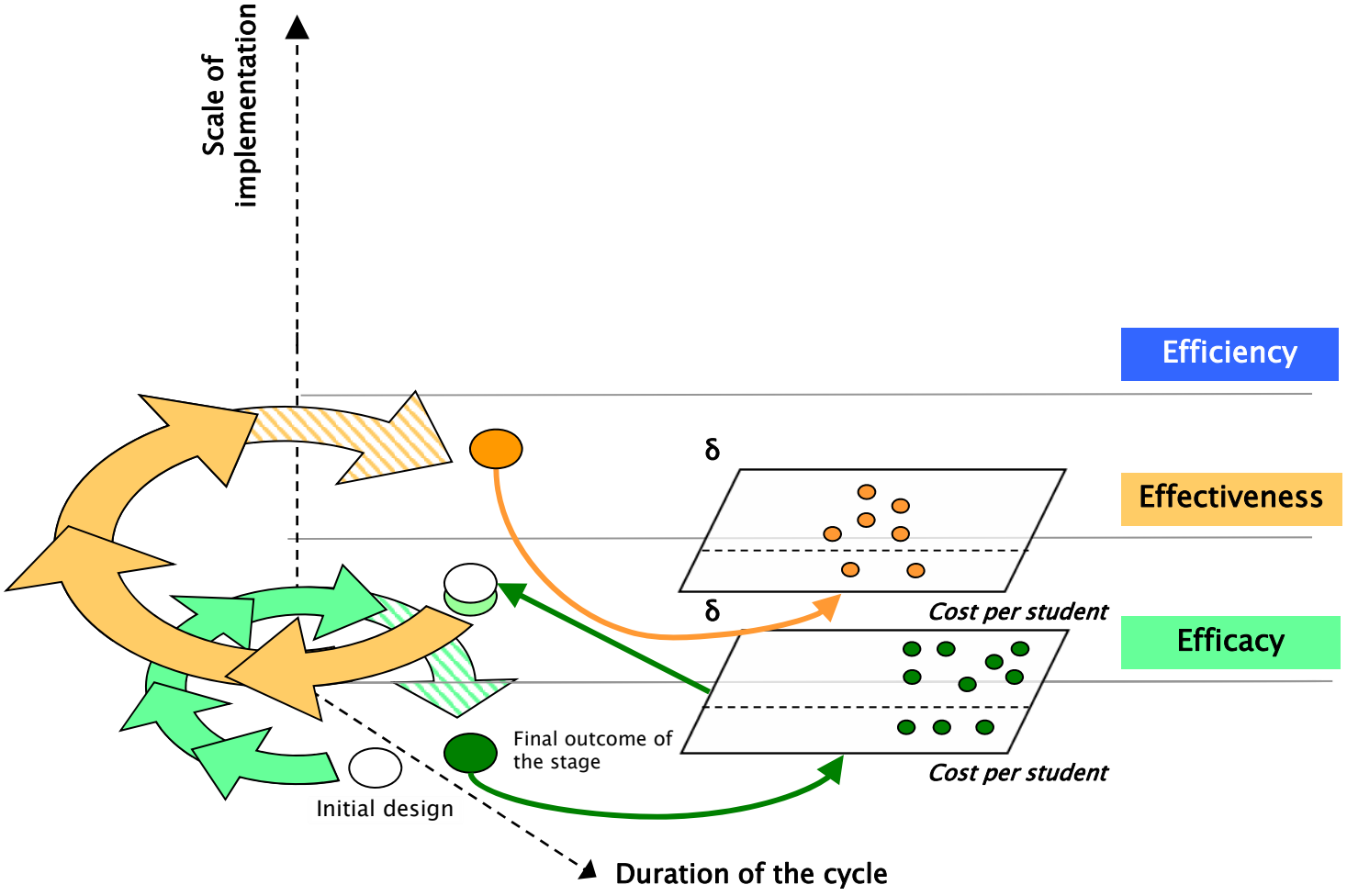
Applications

Development of an ICT4E policy



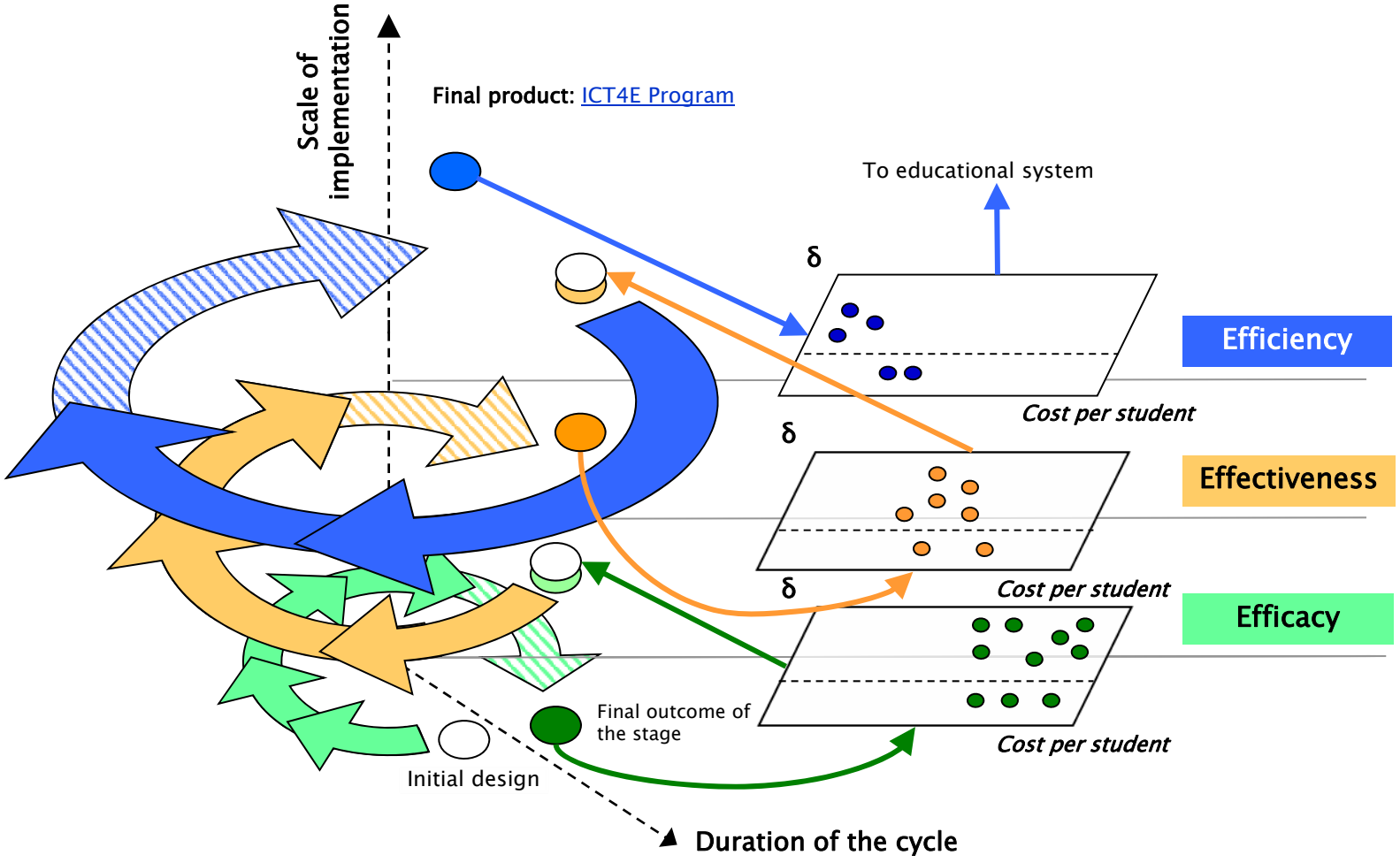
Applications

Development of an ICT4E policy



Applications

Development of an ICT4E policy



Conclusions

Conclusions

Pros

- Develops ICT4E programs based on rigorous evidence of the real effectiveness of the pedagogical model, intervention and transference
- Gives the decision-maker tools to build a public policy for the development of ICT4E programs
- Provides guidelines for evaluating grant proposals, and the projects themselves
- Educational policies are defined based on the specific schools needs, diversifying the equipment in schools

Conclusions

Cons

- Formative and summative evaluation methodologies require long-term alliances between researchers, schools and politicians
- Public and/or private agencies must be prepared to support this process to achieve the expected results
- It can take more time and resources than initially expected

Conclusions

Challenges (i)

- Long term commitment: political and institutional viability to carry out this proposal
- Evaluation requires specific technical abilities: governments must collaborate with specialized institutions, such as universities and research centers
- Requires long term incentives for researchers which currently are rewarded mainly by publishing

Conclusions

Challenges (ii)

- Evaluation standards for each stage, which can be objectively and transparently applied
- Ethical issues regarding educational research in real settings
- Standards for the calculation of the total cost of the program, to calculate, compare, and make transparent the differences between several proposals

World experience

- (Some) key players:
  - Government and Research agencies (e.g.)
    - BECTA, Education.au, Enlaces, KERIS, LSL
    - FutureLab, Mathematica Policy Research, SRI International
  - Institutions: (e.g.)
    - Interamerican development Bank (IADB)
    - World Bank (InfoDev)
    - United Nations (CEPAL, UNESCO)
    - OECD

World experience

World experience

- (Some) specialized journals:
  - British Journal of Educational Technology
  - Computers and Education
  - Educational Evaluation and Policy Analysis
  - Education and Information Technologies
  - Educational Technology and Society
  - Journal of Educational Research
  - Review of Educational Research

O impacto das TICs na educação
El impacto de las TICs en la educación
The Impact of ICT in education

"Assessing Impact of ICT on the quality of education"

Patricio Rodríguez
Miguel Nussbaum

Department of Computer Science
College of Engineering
Pontificia Universidad Católica de Chile

28.04.2010