Teaching & Learning with ICT

CITE Seminar Monday 18 March 2002

…in the next century, …any changes in educational technology are likely to be evolutionary rather than revolutionary,

(Saettler, 1990)

or

is it?

Evolutionary

- Change with strategy and direction (dichotomise)
- Point of no return: 'species formed' (genome with extra/mutated bits of DNA-fundamental of teaching)
- Survival of the fittest: to become indispensable or become 'extinct'; adaptability (usability & acceptance)
- Early fragile stage (fit into pyramid- pedagogy)

Revolutionary

- It is not an uprising
- It is successful with no martyrs but heroes
- Paradigmatic shift
- Change of ways of life: new adopted pedagogy, new 'species', have to survive or face rebellion or topple by another revolution

Needs to change -->
Opportunities (Tung)
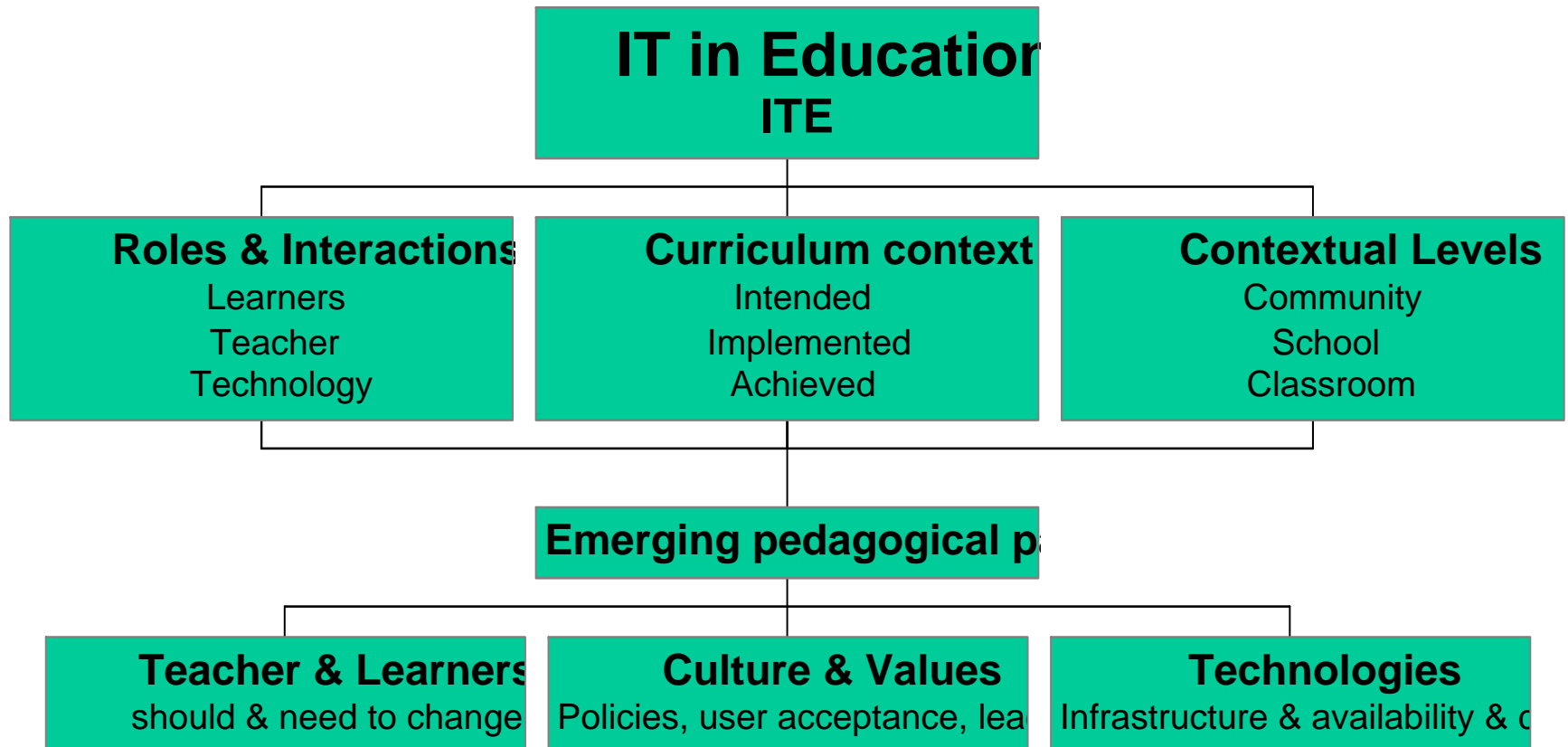Co-existence

Educational and Instructional Technology

- Educational technology – WW Charles (1948)

- Instructional technology – James Finn (1963)

- History of technology emphasised radio and TV 15 years ago (Cuban, 1986)

- Edu tech is a process and use rather than a product (Saettler, 1990; Muffoletto, 1994)

Learning & Teaching Environment

- **Environment** is where the instruction takes place and includes also the method, IT resources, and the technologies (ICT) needed to convey information and guide the learner's study.

- The **learning environment** includes the physical facilities, the psychological atmosphere, instructional methods, media, and technologies (Heinich, *et al.,* 2001: 6)

- **Learning process** involves the selection, arrangement, and delivery of information in an appropriate environment and the way learners interact with that information.

IT in Education

(Law, 2000; Robitaille, 1996)

IT in Education
ITE

Roles & Interactions
Learners
Teacher
Technology

Curriculum context
Intended
Implemented
Achieved

Contextual Levels
Community
School
Classroom

Emerging pedagogical pa

Teacher & Learners
should & need to change

Culture & Values
Policies, user acceptance, lea

Technologies
Infrastructure & availability & o

Technology in Education

- Technologies and resources, instructional systems, and computer-based support systems

- Computer roles in instructional systems

- Technology resources

- Pedagogues for integrating computer-driven technology and software into classroom activities

ICT in Education: History

- **Audio-visual movement** (1930s): educational theory and practice concerned primarily with the design and use of messages which control the learning process

- Audio-lingual movement (1950s)

- **Instructional design**

  – (1960s-70s): based on the belief that both human and non-human resources can address educational needs

  – (1980s): influenced by behaviourist theories and later by cognitive theories

  – (1990s): popular learning theories of non-systemic approaches, based on integration

  – Reflects the need for technology to enhance training in specific job skills

eg., every student should learn word processing; vocational training as a means of teaching

- Technology in education as computers and computer-based systems:
  - (1950s) potential as educational tools
  - (1960s-1990): educational computing, encompassing both instructional and support applications of computers
  - (1970s): those involved with media, AV communications and instructional systems directing the course of research and development in educational computing
  - (1990s): Computer as a combination of technology resources, including technologies and resources, instructional systems, and computer-based support systems → educational technology

Models of ICT Supported Pedagogical Practices

Model

- unique framework that organises relations between variable causes and effects (Ransdell, et al., 2001)
- Two models (for a structural equation modeling) :
  - conceptual model - serves as a theory of why a pattern of relations should take a certain form
  - statistical model- provides confirmatory evidence for the hypothesised patterns in those conceptual models
  - If data fit the conceptual model, underlying theory supported

Instructional Role of ICT

- Technology in education as vocational training tools (technology education)

- Computer as a tutor, a tool, or a tutee. (Taylor, 1980)

- Computer as cognitive tools (Solomon, 1986)
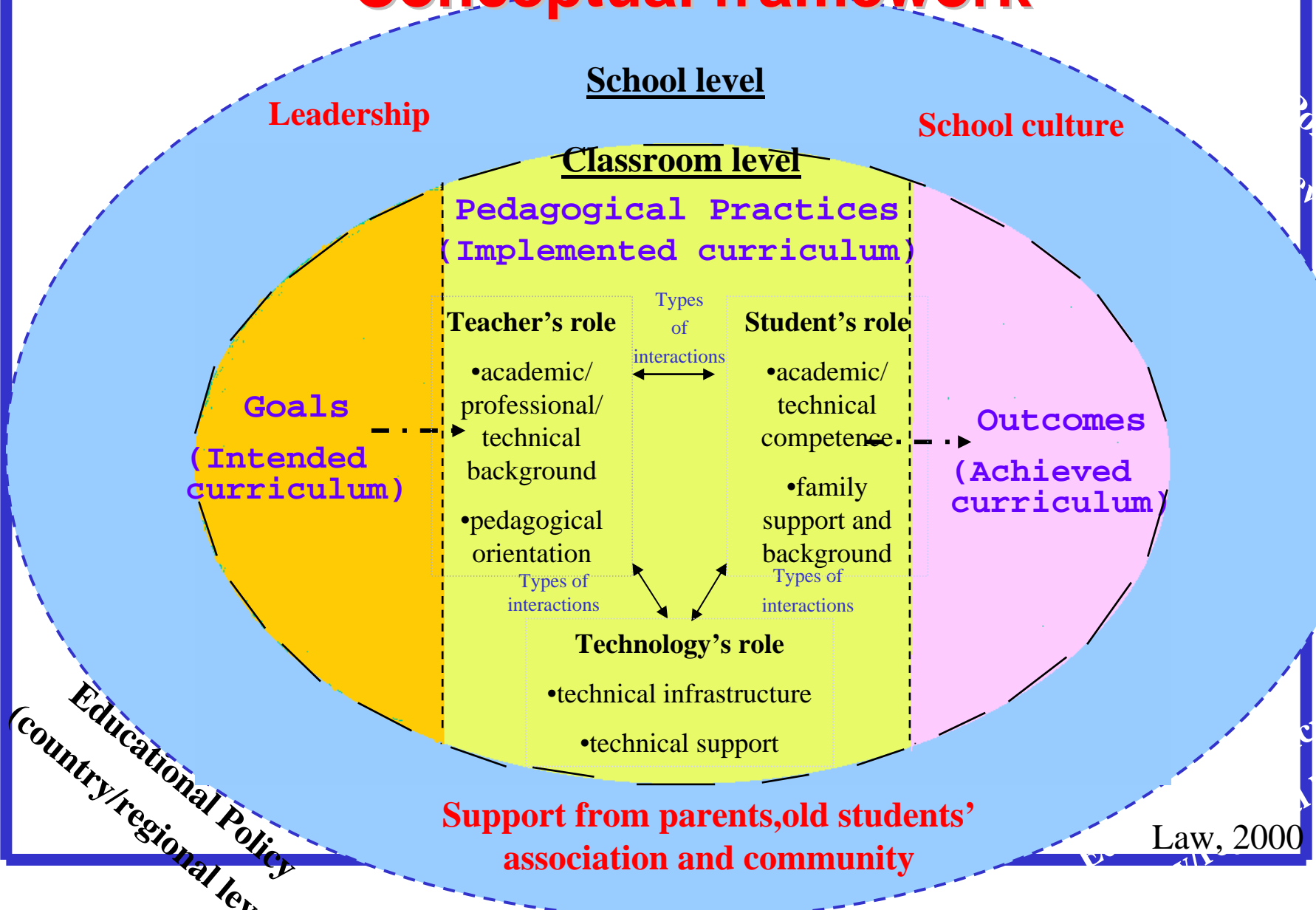
- Computers as mindtools (Jonassen, 2000)

ICT Implementation plan

Integrate?

Yes → Change Strategy

No → Discarded
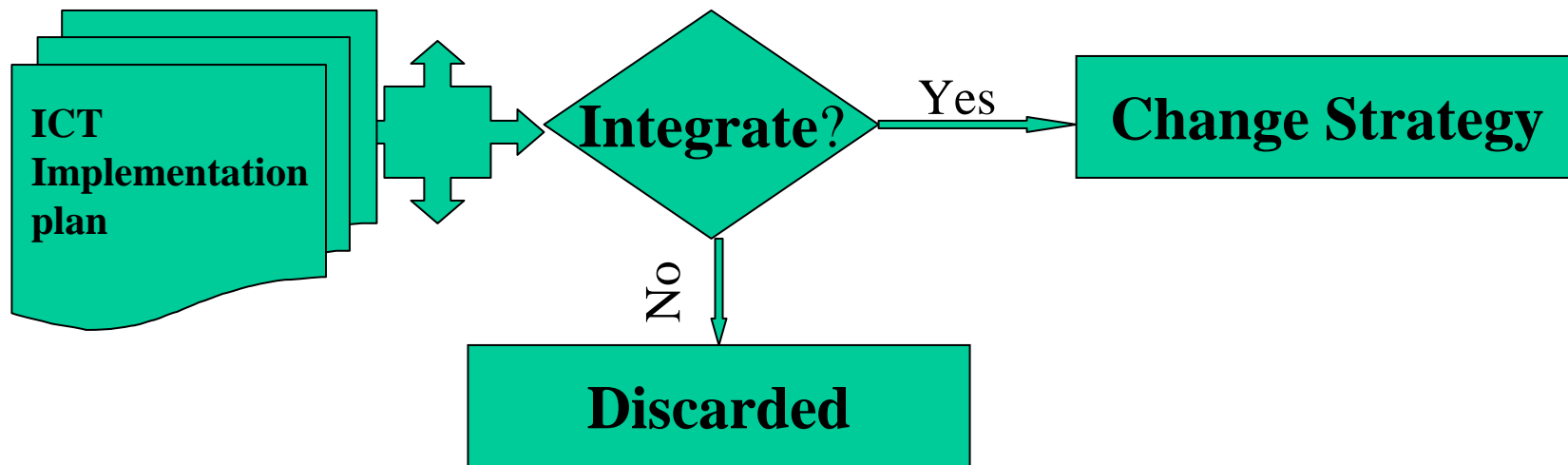
Everything should be made as simple as possible, but not more so"

Albert Einstein.

Integration

- Integrate ICT into the curriculum
- Integrate ICT into the pedagogy
- Integrate ICT into the teaching environment
- Integrate ICT into the learning environment
- Recognise the factors impacted upon the implementation of ICT in education ("survival")
- Recognise and incorporate the current trends toward thematic, interdisciplinary instruction
- Recognise the roles played by teachers, students and ICT ❑(Law, et al, 2000)

Conceptual framework

School level

Leadership

School culture

Classroom level

Pedagogical Practices (Implemented curriculum)

Teacher's role

- academic/ professional/ technical background

- pedagogical orientation

Types of interactions

Student's role

- academic/ technical competence.

- family support and background

Goals (Intended curriculum)

Outcomes (Achieved curriculum)

Types of interactions

Types of interactions

Technology's role

- technical infrastructure

- technical support

Educational Policy (country/regional level

Support from parents,old students' association and community

Law, 2000

Models of Change for ICT Implementation at School Level (Yuen, 2000)

Schools: history, background, school culture, vision and philosophy, leadership, staff (teachers & administrators), students, parents, curriculum innovation/reform, staff professional development, ICT implementation strategies, etc

3 models of changes are observed

Technological Adoption Model
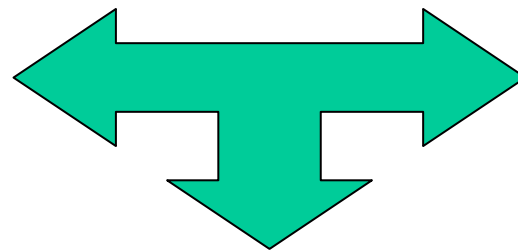
Catalytic Integration Model

Cultural Integration Model

1. *Technological Adoption Model*

- enhances teaching effectiveness and ICT competence of students are perceived as the main objectives of ICT implementation

- expository and inductive approaches

- the main role of ICT is to enhance the effectiveness of information presentation and to stimulate student interest

- have strong leadership

2. *Catalytic Integration Model*

- characterized by a visionary school leader

- the use of ICT in teaching and learning is deliberate and designed as an integral part of the curriculum

- Task-based, Problem-based and Social-Constructivist approaches.

- strong curriculum leadership with continuous professional development programs

- student-centred approaches and involve staff collaborations and curriculum innovations

3. *Cultural Integration Model*

- schools with strong cultural and historical foundations; non-coercive culture of the school, the introduction of ICT is not seen as a threat

- the diversified pedagogical practices

- no compulsory staff development program

- integration depends on the belief of the teacher involved

Pedagogical approaches in using ICT

| Change Models	Expository Approach	Inductive Approach	Task-based Approach	Problem-based Approach	Social-constructivist Approach
Technolo-gical Adoption Model	✓	✓			
Catalytic Integration Model			✓	✓	✓
Cultural Integration Model	✓	✓	✓	✓	✓

Table 1. Relation between the change models and pedagogical practices in HK classrooms (adapted from Law et al (2000)

Kluge 's Integrated Model
of Teaching Program (1994, 1999)

- National Conference on Computers and Composition, Nagoya (1994)
- Applied to Computer-assisted Language Learning, CALL program: factors

Theoretical Aspects of CALL

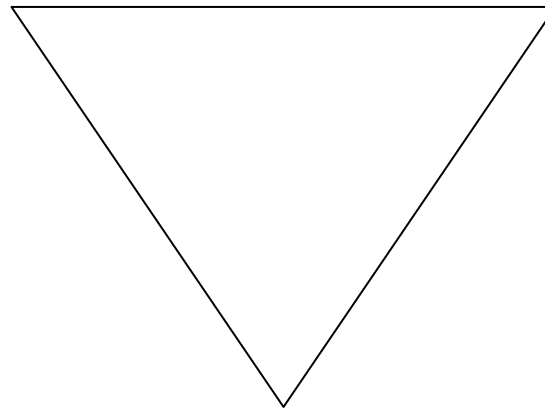**Educational Philosophy**
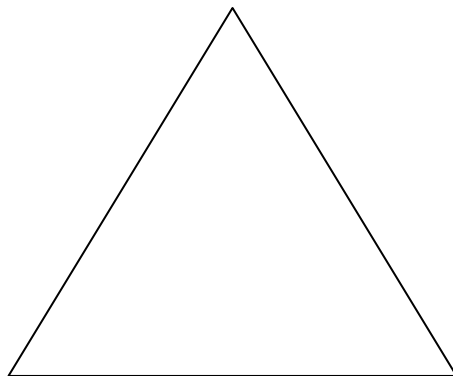
(of institution)

Curriculum　　　　**Pedagogical Theory**

Practical Aspects of CALL

Hardware   **Software**

People

Kluge's Interconnected Elements of CALL
(1994)

Educational Philosophy
(of institution)

Hardware
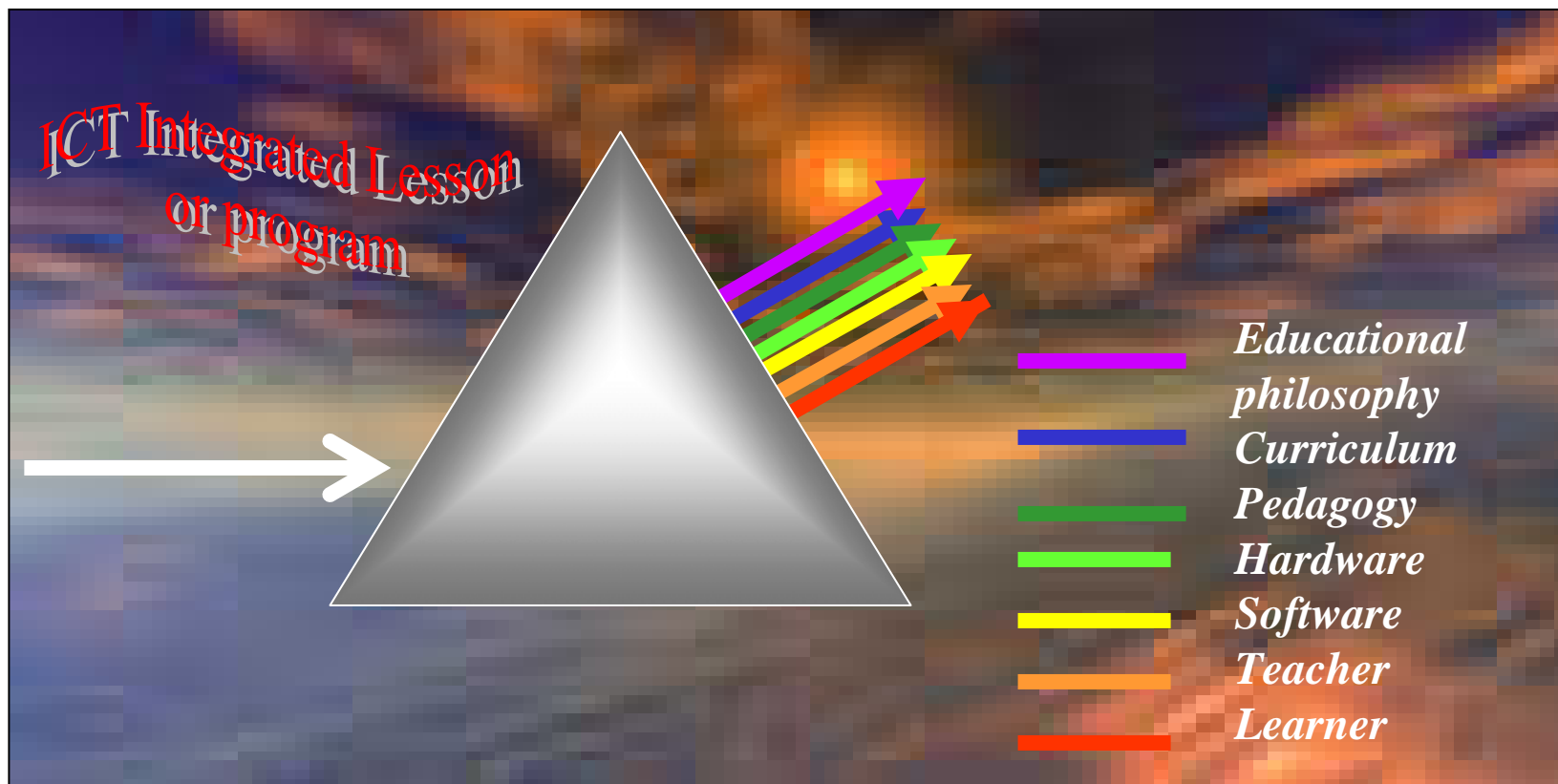
Software

Curriculum

Pedagogical Theory

People
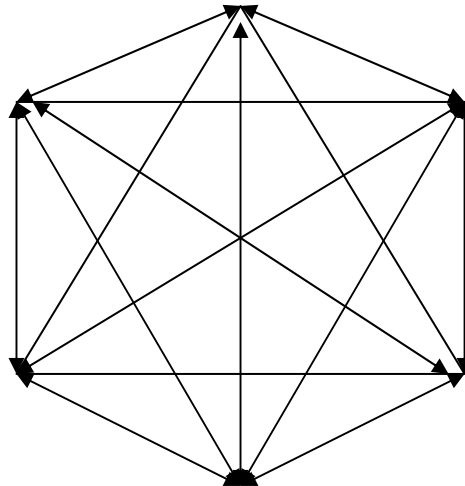
ICT Integrated Model
of Pedagogical Program

achieng, HKU@2002

Integration

Integrated!

Spectrum of each factor
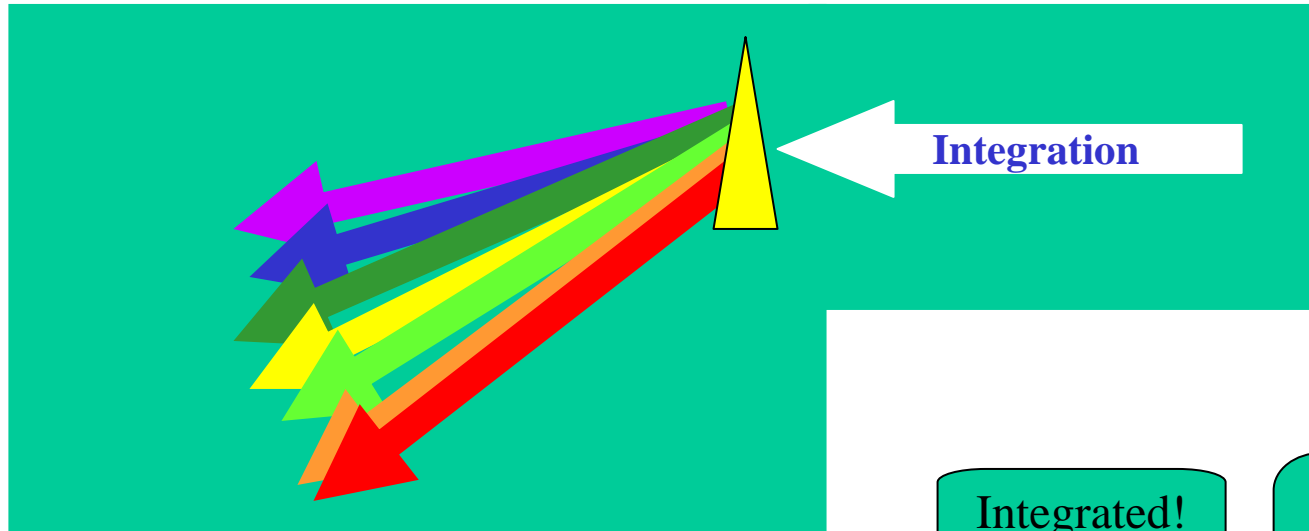
"Spectrometric analysis" of ICT-curriculum integrating factors

achieng, HKU@2002

Teacher factor

Academic, professional, technological background; ICT user acceptance

**Learning
& Teaching
Environment**

ICT

**other innovations
e.g. professional
development**

User
acceptance

Cost
leadership

Enlarge
in size!

Reduce!
Fund cut,
etc
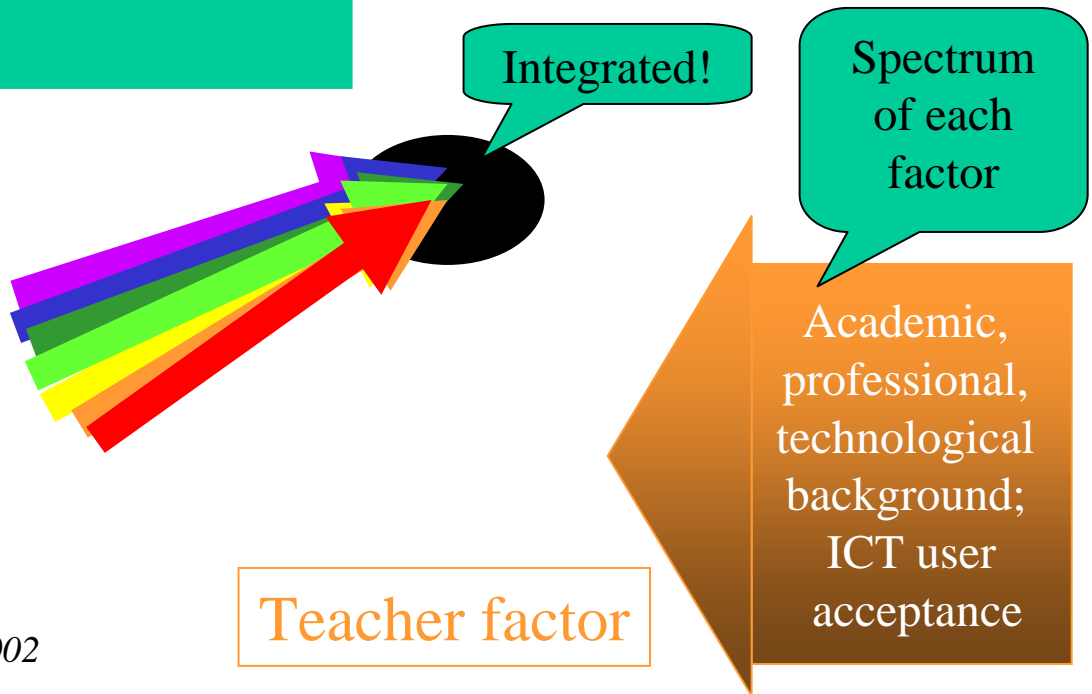
achieng, HKU@2002
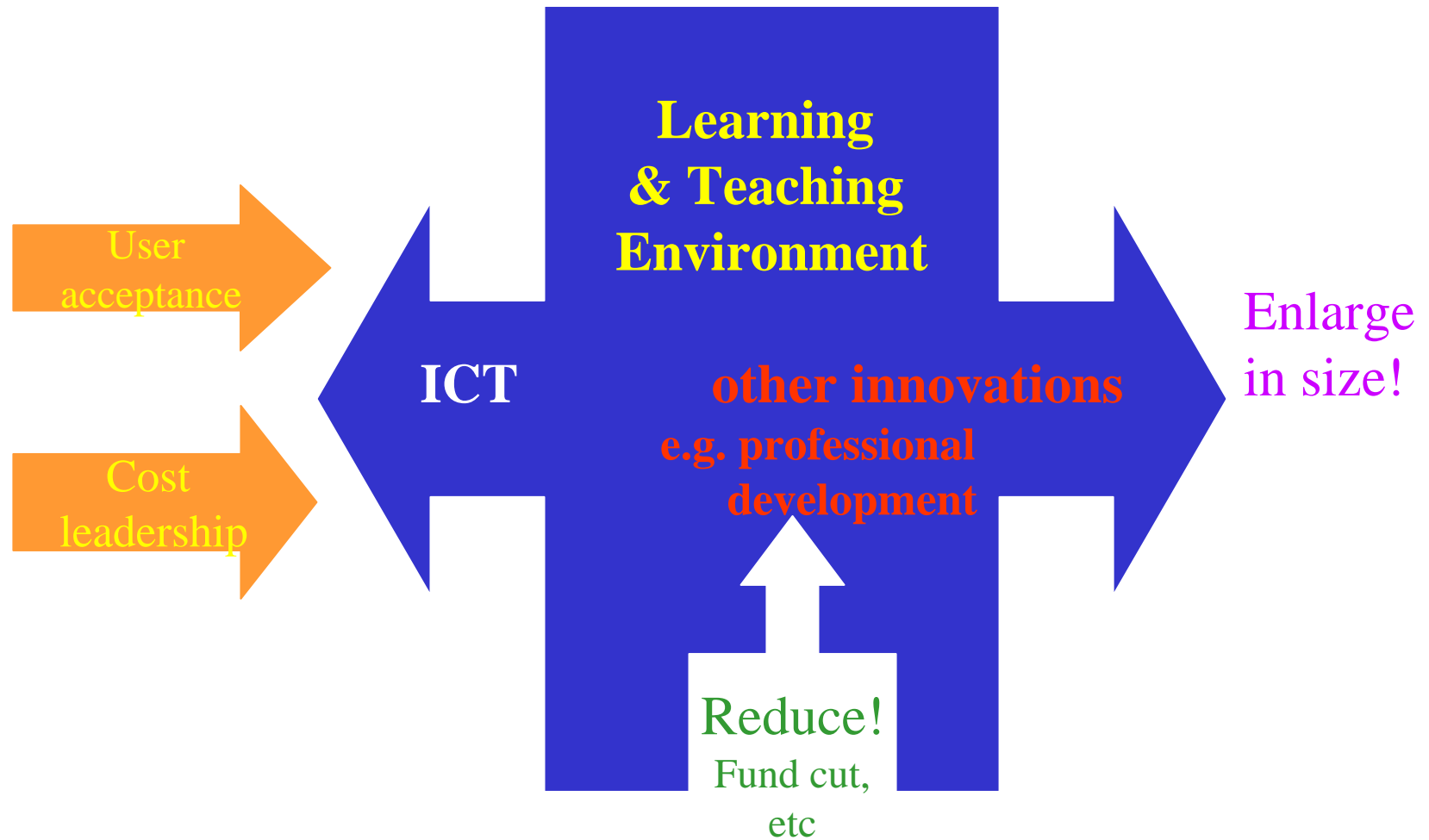
ICT-related Expansion of T&L Environment

School and principal's support, enhanced teacher ICT skills, knowledge and pedagogues, ICT-readiness of students, ICT ease-of-use, parent buying PCs, ICT-curricular resources, ICT funding & support

achieng, HKU@2002c

User Acceptance of ICT

- Understanding why people reject and accept ICT has proven challenging issues (Swanson, 1988)

- Studies of impact of users' internal beliefs and attitudes on their usage behaviour by various factors (DeSanctis, 1983; Swanson, 1974, 1987)

  – design, system used, implementation process, user involvement and development, cognitive styles

- Adequate theoretical and psychometric measurements (Davis, Bagozzi & Warshaw, 1989)
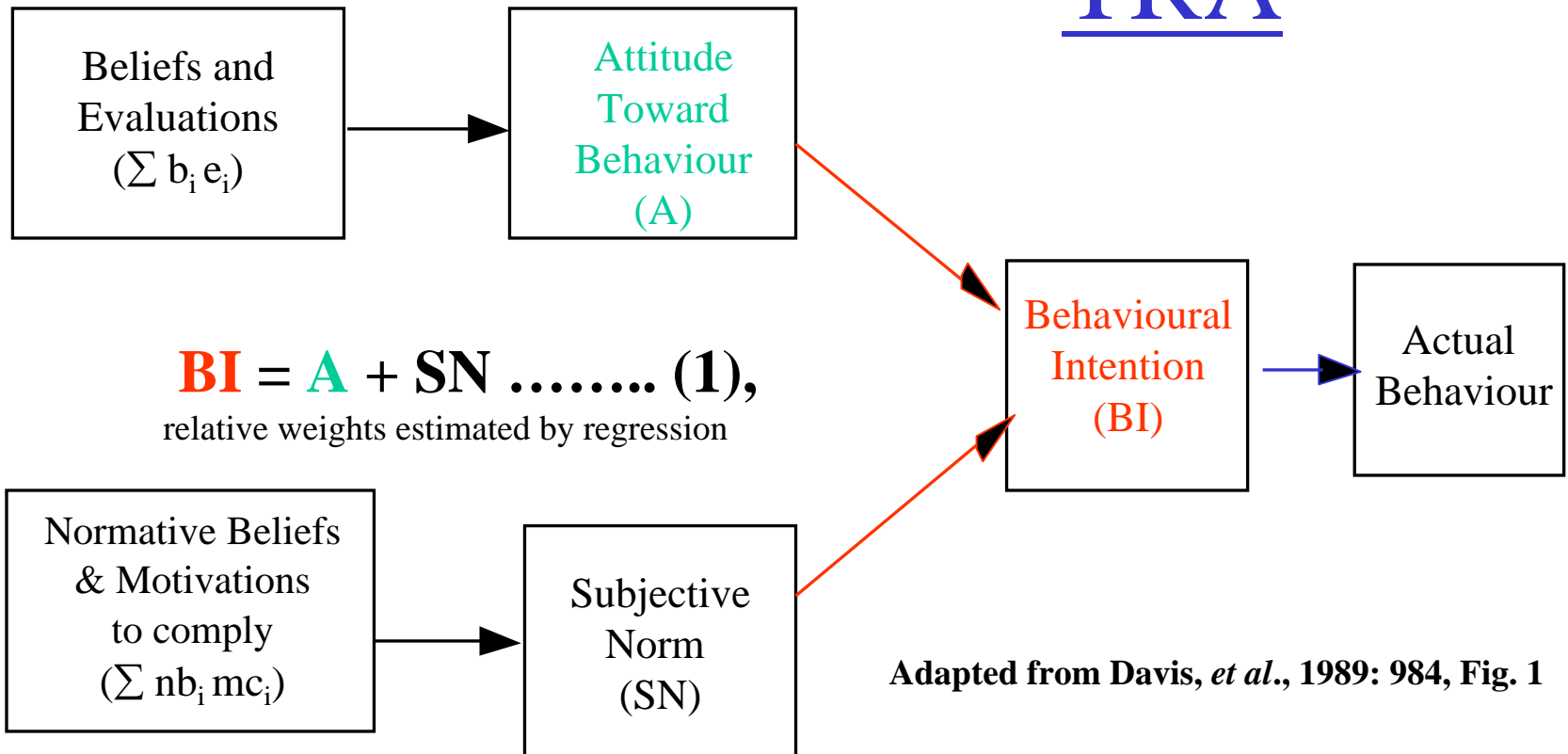
Intention Models

- Social psychology (Swanson, 1982; Christie, 1981)

- Theory of Reasoned Action (TRA)

- Technology Acceptance Model (TAM) (Davis, 1986)

- computer usage behaviour - uses TRA as theoretical basis for specifying casual linkages between perceived usefulness and ease of use, and user's attitudes, intentions and actual computer adoption behaviour

Theory of Reasoned Action

- TRA

- Fishbein & Ajzen (1975 & 1980)

- TRA is "*designed to explain virtually all human behaviour*" (1980: 4)

- Person's behaviour (BI) determined by person's attitude (A) and subjective norm (SN) concerning the behaviour

TRA

| Beliefs and Evaluations ($\sum b_i e_i$) | → | Attitude Toward Behaviour (A) |

$$\mathbf{BI} = \mathbf{A} + \mathbf{SN} \ldots\ldots (1),$$

relative weights estimated by regression

| Normative Beliefs & Motivations to comply ($\sum nb_i mc_i$) | → | Subjective Norm (SN) |

| Behavioural Intention (BI) | → | Actual Behaviour |

Adapted from Davis, *et al*., 1989: 984, Fig. 1

$$\mathbf{A} = (\sum \mathbf{b_i e_i}) \ldots (2) \qquad \mathbf{SN} = (\sum \mathbf{nb_i mc_i}) \ldots (3)$$

$$BI = A + SN$$

- One's intention for behaviour = feelings about performing + perception of people important to him (specific referent individuals or groups) think he should or should not perform

$$A = (\Sigma\, b_i\, e_i)$$

- Attitude = (subjective probability that performing the behaviour will result in consequence, i)

    x   (evaluative response to consequence)

- an information–processing view of attitude formation and attitudinal change due to impact of external stimuli on belief's structure

$$SN = (\Sigma\, nb_i\, mc_i)$$

Individual subjective norm

= **multiplicative function of normative beliefs (nb_i)**

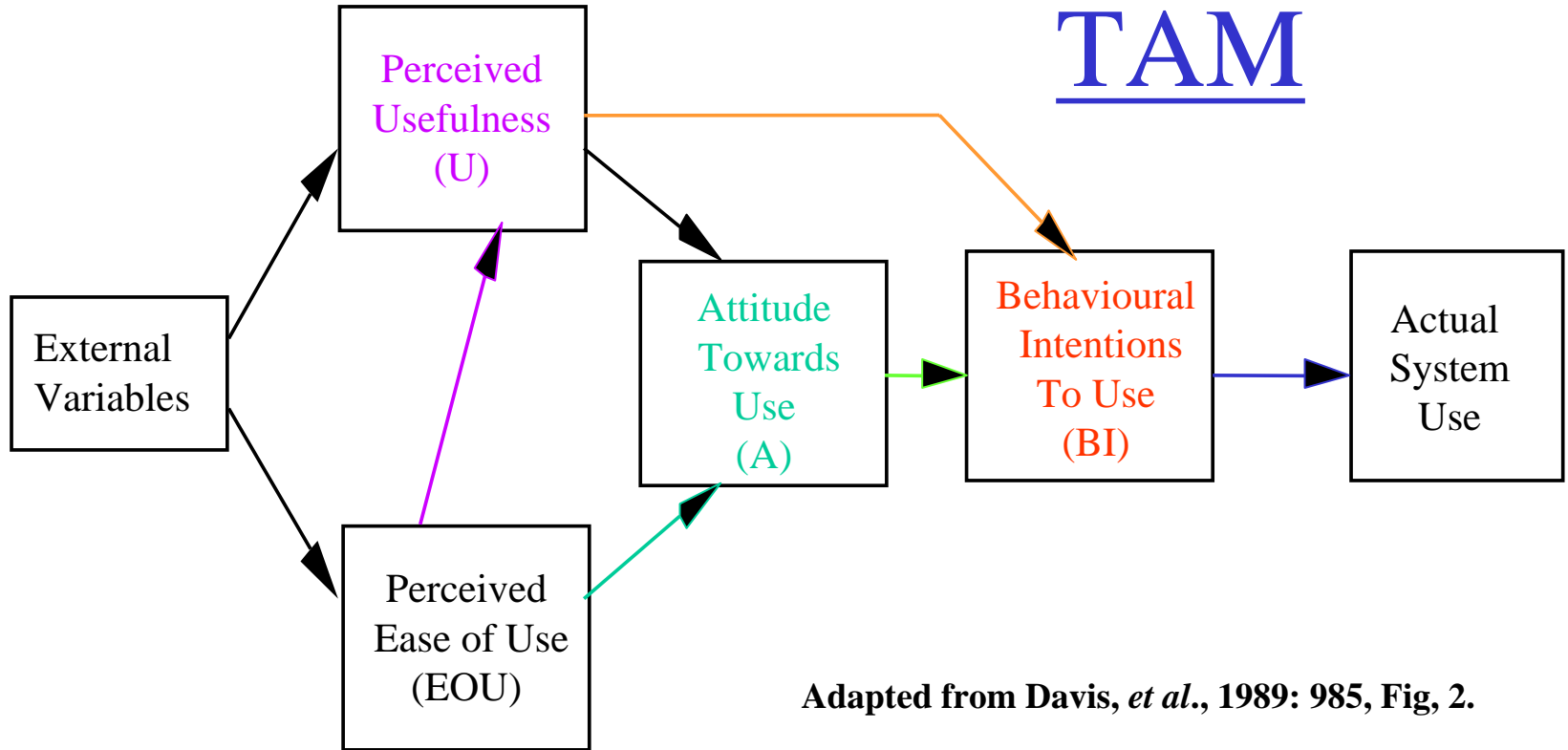x **motivation to comply with perceived expectations (mc_i)**

– using free response interviews with subject population to obtain salient beliefs.

- Factors affecting behaviour only indirectly on A and SN.
- For ICT perspective, variables such as system design characteristics, user characteristics, task characteristics, implementation process, political influences, organisational structure (Ajzen & Fishbein, 1975)
- TRA mediates the impact of uncontrollable and controllable interventions on user behaviour
- TRA captures the internal psychological variables through which numerous external variables achieve their influence on user acceptance.

Technology Acceptance Model

- TAM, tailored for modeling user acceptance of ICT (Davis, 1986) based on cognitive and affective determinants, a theoretical backdrop for modeling relationships among these variables

- data on computer usage behaviour to predict and explain phenomena

- uses TRA as theoretical basis for specifying casual linkages between two particular beliefs: perceived usefulness (U) and ease of use (EOU) (Davis, *et al.*, 1989; Swanson, 1987)

TAM

External Variables

Perceived Usefulness (U)

Perceived Ease of Use (EOU)

Attitude Towards Use (A)

Behavioural Intentions To Use (BI)

Actual System Use

Adapted from Davis, *et al*., 1989: 985, Fig, 2.

$$\mathbf{BI} = \mathbf{A} + \mathbf{U} \qquad \ldots\ldots(4), \text{ relative weights estimated by regression}$$

$$\mathbf{A} = \mathbf{U} + \mathbf{EOU} \quad \ldots\ldots(5), \text{ relative weights estimated by regression}$$

- provides a basis for tracing the impact of external factors on user's internal attitudes, intentions and actual computer adoption behaviour, and is influenced by external factors

- does not include TRA's subjective norm (SN) - indirectly affecting BI via A due to internalisation and identification process or via compliance

$$\textcolor{red}{BI} = \textcolor{teal}{A} + \textcolor{purple}{U}$$

Computer usage

= Attitudes towards ICT + Perceived usefulness

- A-BI relationship: people form intentions to perform behaviours toward which they have positive affect

- U-BI relationship: people form intention irrespective of feelings evoked, it is a direct effect based on a cognitive appraisal on performance

- This is because enhanced performance is instrumental to achieving rewards which 'work extrinsic' (Vroom, 1964), and towards one's goal hierarchy.

A = U + EOU

- Attitudes toward ICT = Perceived usefulness + Ease of usage

- U-A relationship: positive effect, through learning ICT and affective-cognitive consistency mechanisms (Bagozzi, 1982, Barrett, *et al.,* 1968)

- EOU-A relationship: positive effect on one's intrinsic affect, effort persistence and motivation due to the inborn drives for competence and self-determination, through self-efficacy and personal control (Bandura, 1982; Lepper, 1985) and instrumentality (Swanson, 1987) of ICT

U = EOU + External variables

Perceived usefulness = Ease of use + external variables

- EOU contributes to increased performance and productivity (effort, time, quality)

- EOU-U relationship: direct

- Eg. a more accurate forecasting ICT system is more useful (U) system than one which is equal easy to operate (EOU). Hence, the objective design characteristics of a system has a direct effect on U and indirect effect via EOU (Benbasat & Dexter, 1986)

- **External variables** include system features, training, documentation, ICT support, internal beliefs, attitudes and intentions, individual differences, situational constraints, managerially controllable interventions

To be successful, we need to

Establish National Educational Technology Standards for Teachers, standards for teachers and technology leaders are critical to the development of new learning environments for integration of technology.

Equally necessary are:

- establish the underlying conditions for supporting educational environments with technology,
- adhere to national accreditation standards,
- prepare educational leaders,
- assess and evaluate technology effectiveness, and
- sustain progress through professional development.

(ISTE, 2002: http://cnets.iste.org/index3.html)

Shared Vision

Shared Vision:

- Defined as the presence of proactive leadership and administrative support, shared vision means that the commitment to technology is systemic.

- From the leadership to the grounds personnel, there is an understanding of, commitment to, and sense of advocacy for facilitating the implementation of technology across all entities in the campus and the school site.

Access to ICT

- **Access:** to current technologies, software, and telecommunications networks. However, this access must be consistent across all of the environments necessary for teaching.

- access to ICT appropriate to the subject areas being studied classroom, lab settings and provisions

- Access at home/I-café/public libraries/etc

- accessible immediately when technology provides the best route to the information or tools needed by the teacher and students.

Integration, integrate what?

- Integrated lesson, subject areas
- Integrating

> e.g. English across the curriculum
>
> *Potunghua* across the curriculum
>
> ICT across the curriculum
>
> ICT into the teaching/learning environment
>
> subject areas with ICT

Why possible now?

Important changes (user acceptance):

- A critical number of computers (reduced cost);

- An increase in the number and types of software;

- A dramatic shifts in beliefs about fundamental goal of education and strategies in education itself;

- An ease of use (user friendliness);

- Better understanding what ICT can and can't;

- We are (administrators, politicians, teachers, students) ready now;

- Current teaching practices emphasise using realistic contexts for teaching

Brody's Model (1995): Planning Guide

- Step 1: Create a "merged version"
- Step 2: Assess the current status
- Step 3: Set goals
  - ("developing a guiding framework": Dyrli and Kinnaman 1994a)
- Step 4: Develop activities
- Step 5: Implement the plan
- Step 6: Evaluate the plan

A Technology Planning Guide
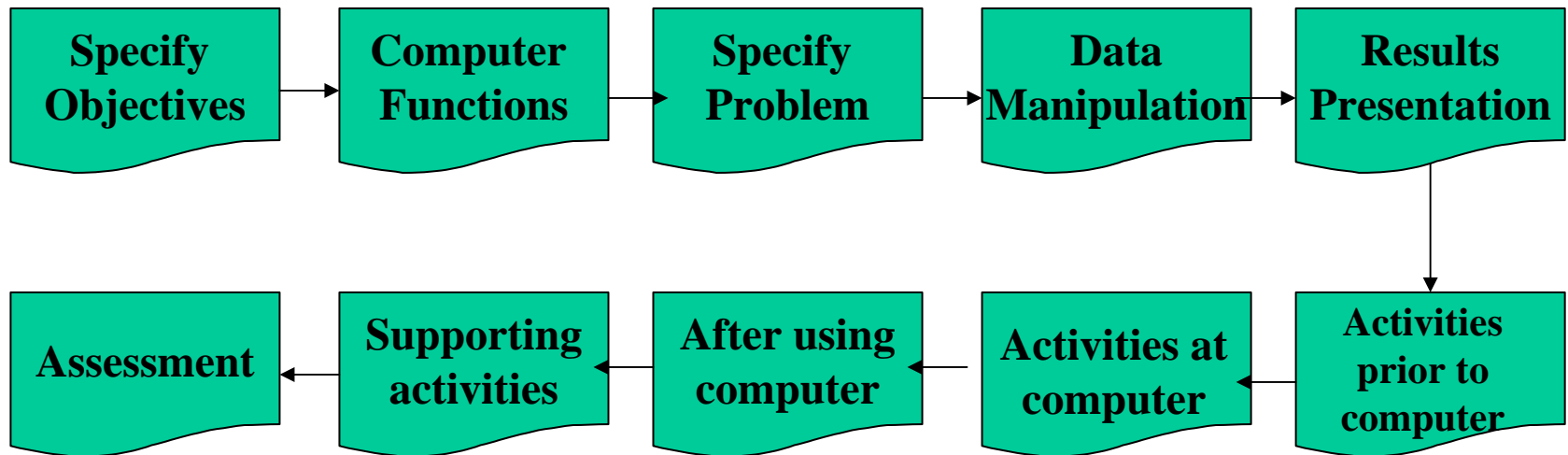### (Roblyer, et al. 1997)

- Step 1: Create a "MERGED VISION"

- Step 2: Assess the current status

- Step 3: Set goals

- Step 4: Develop activities

- Step 5: Implement the plan

- Step 6: Evaluate and revise the plan

Good Planning
(Roblyer, Edwards & Havriluk, 1997)

- Planning should continue at all levels
- Involve teachers and other personnel
- Budget for ICT expenses
- Making funding incremental
- Emphasise teacher training
- Applying ICT to needs and integrate curriculum
- Keep current and build in flexibility
- Planning essential and mistakes

Designing an Integrated Lesson

| Specify Objectives | → | Computer Functions | → | Specify Problem | → | Data Manipulation | → | Results Presentation |

| Assessment | ← | Supporting activities | ← | After using computer | ← | Activities at computer | ← | Activities prior to computer |

Adapted from Fig. 4.1. *NTeQ Model.* Morrison and Lowther (2002: 65)

Classroom Pedagogical Shifts
### (Collins, 1991)

- From whole class to small-group teaching
- From lecture and recitation to coaching
- From working with better students to weaker ones and those at risk
- Towards more engaged students
- From text-based assessment to that based on products, progress, and effort
- From competitive to cooperative social structures
- From all students learning the same things to different students learning different things
- From primarily verbal learning to an integration of visual thinking

Teachers need to ask this question:
What are some negative effects of technology, particularly with:
Internet?
Educational software?
Computer?

An
ICT-rich and human-poor educational environment

A Philosophical Perspective on ICT Teaching/Learning

(Heinich, et. al. 2001: 9, adapted Fig.1.2)
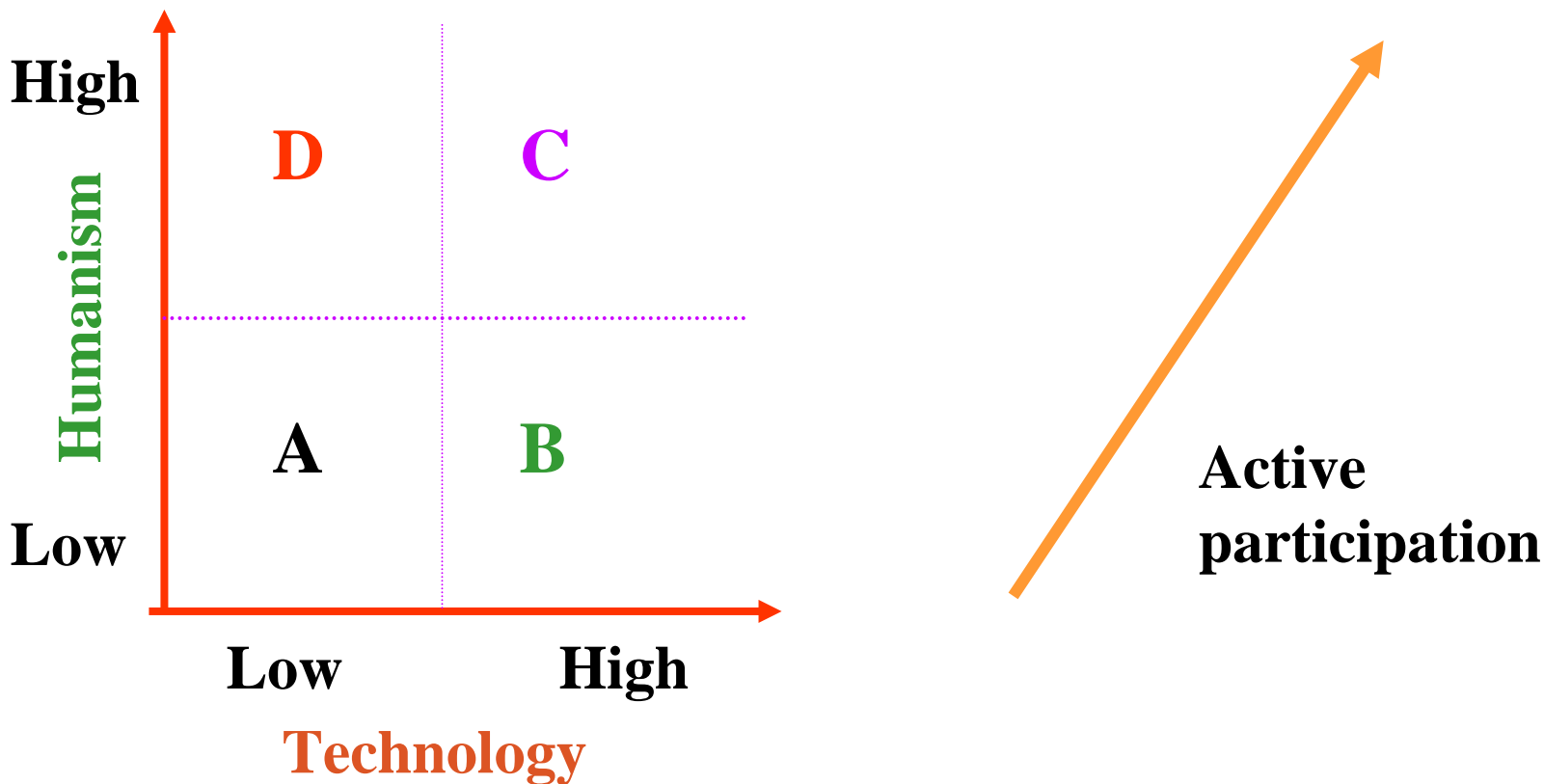
Examples

A: PowerPoint-based lecture with no interaction

B: "Packaged" computer-based lessons with little
   teacher instruction (instructor-independent
   instruction)

C: Student-selected computer-based topic with
   periodic interaction between student and tutor

D: Group discussion or evaluation of ICT
   software

Web-based Environment

- R. Oliver and A Omari (2001)
  - Study on web-based environment supporting problem-based learning with 240 multimedia education students
    - 20% dissatisfied with the course
    - 51% preferred material taught directly
    - 52% preferred to be taught things than to have learn them themselves
    - 50% preferred to do weekly problems on their own
    - 21% did not share the work
    - 26% reported technology in supporting the learning process unreliable

Collaborative Culture

- Collaborative culture (teaching & learning)
- The power of collaborative learning
- Need to be taught or not?

  - both the teacher and the students

  - individual learning objectives, preferences and capabilities (Westera, 1999)

- Instructor needs to be a 'true blue' (believer) himself/herself first!

Power of
Cooperative/Collaborative Learning

- Shared intelligence or pooling of it
- Learning by teaching
- Learning companion
- Learning by doing together
- Student-centred learning
- Problem solving & critical thinking
- Learning how to learn
- Social skills

An ICT-literate Teacher

- Create relationships between active learning and teaching
- Develop an appreciation and an understanding of ICT potential
- Learn to be authors
- Develop leadership skills and become role models for successful integration
- Design integrated curriculum with ICT
- Work with cross-disciplinary colleagues to integrate subject areas
- Learn the benefits of ICT in the classroom

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- Develop ownership if ICT through authentic experiences
- Learn to motivate students with ICT
- Achieve success by becoming informed and reflective decision makers
- Become advocates for ICT integration
- Match ICT objectives with students, etc
- Match learning tasks with ICT function and objectives
- Problem context should be anchored in a realistic setting that has meaning for the students and motivates them (CTGV, 1984)

Strategies issues

- Use direct strategies
  - Learning by examples (tutor-tutee)
  - Learning by doing
  - Learning by teaching (Kaplan, 1998)
  - Learning by disturbing (Frasson & Aimeur, 1996)
  - Learning by analogy
  - Learning using a student model with the wrapping layer of believability and emotional layer (Abou-Jaoude & Frasson, 1999)
  - Learning companion (Gilmore & Self, 1998)

Instructional Transformational Model

(Williver)

1. **Familiarisation** of ICT and its potential use

2. **Utilisation** continuously;

3. **Integration** of ICT as essential for educational process and teachers constantly apply ICT in their classrooms

4. **Reorientation** or rethink the educational goals

5. **Revolution** with the evolving ICT-based classroom across curriculum. ICT becomes an invisible tool.

ICT Constructivism, going against the tide?

- Behaviourist's educational pedagogy in the 1960s...but ICT pedagogy introduces its equivalent in the 1980s

- Cognitivist's educational pedagogy in the 1970s, yet ICT pedagogy introduces it in the 1990s

- Constructivist's educational pedagogy …..ICT pedagogy in the late 1990s…

- → pedagogical orientation and attitudinal "fossilisation"; cultural inertia , 'goes against the tide"

Pilot Study on Objectives of ICT in Education

- Current first year BEd (ITE/LIS) (ITE) part-time students

- Attending core course: "Learning and Teaching with Information Technology"

Research Questions

- From the perspective of teachers: Current ICT objectives applied in schools in HK
- What ICT objectives are important for education?
- What ICT objectives are important for teachers?
- What ICT objectives are important for students?
- Significance of the findings
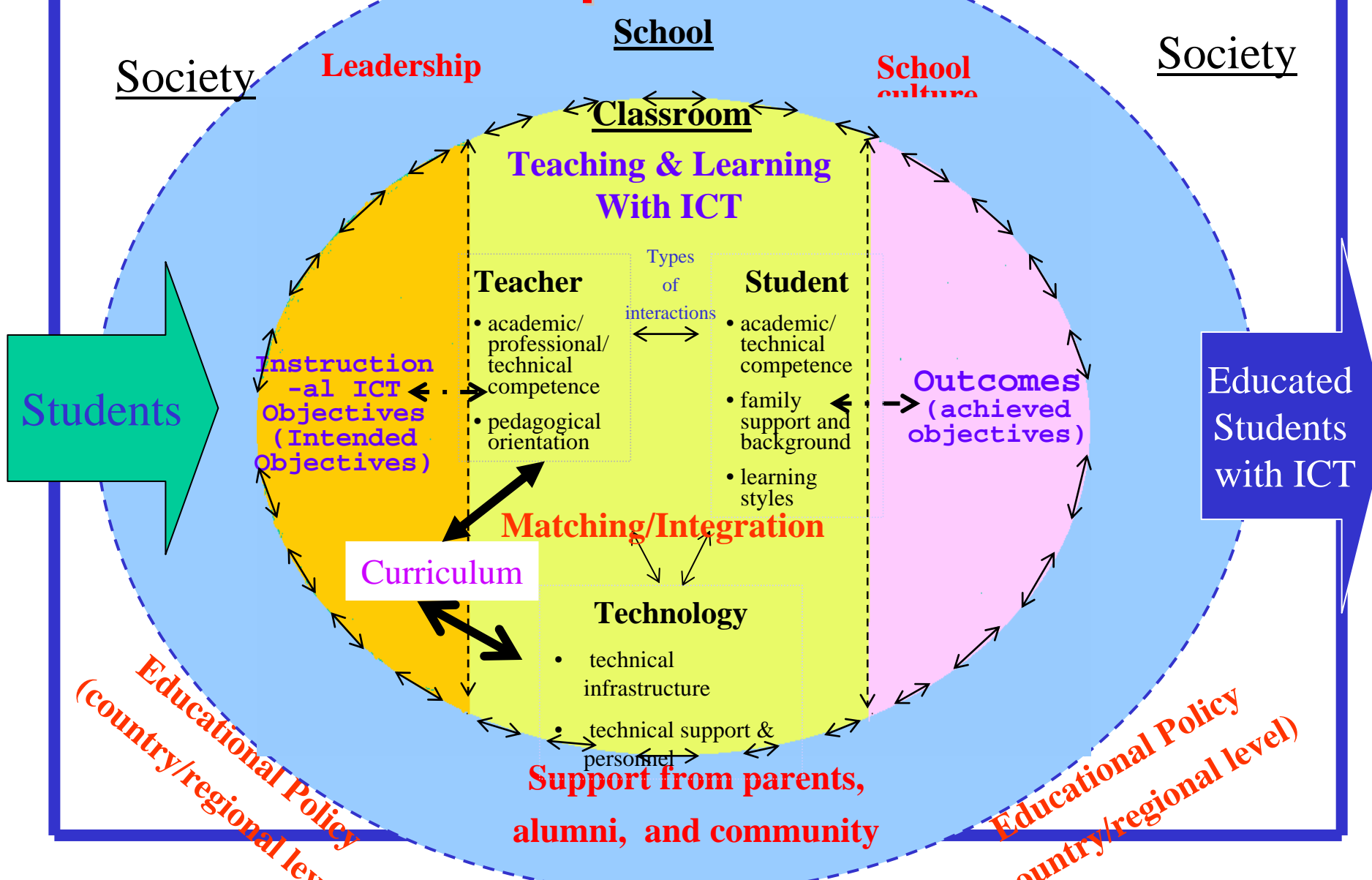
Subjects
BEd students

- 3 groups (78 students): 21 groups
- at least 2-year trained teachers
- randomly from many schools in HK (mostly primary)
- Part-time students
- Questionnaires

Objectives
(Morrison & Lowther, 2002)

- Provide guidelines for instruction

- Focus on what the students will do as a result of the instruction rather than what the teacher will do or the school will provide

- Focus on outcomes or products of the learning process & schooling (what can the student demonstrate)

- Adaptation to standards makes standards more meaningful and realistic

Objectives of ICT in Education

- 19 ICT objectives in education (Yuen 1998)
- Student teachers have to
  1. Rank them (relative importance).
  2. Assess which objectives are included presently: (a) in most HK schools; (b) in some HKschools; and (c) not yet by any HK schools, by ICT-literate teachers, to be best of my knowledge?
  3. Assess which ICT they aim to integrate into their teaching? Why?

ICT Objectives

1. Enable students to make use of IT in their learning.

2. Facilitate new teaching approach and innovative classroom activities which cannot be achieved without IT devices.

3. Enable students to use IT devices.

4. Broaden our students' mind by opening up a world of information to them.

5. IT Education aims at fostering students' creativity and learning of academic subjects.

6. Enable students to learn in a more independent way and to engage in life-long learning.

7. Facilitate educational innovation and improve quality of education.

8. Tighten the linkage between students and the world.

9. Enable students to acquire self-learning skill and foster their creativity.

10. Facilitate teaching and learning process.

11. Facilitate school administration.

12. Prepare students to live in an environment with increasing change both in ICT and knowledge.

13. Enhance the linkage between schools and the world, so as to expand and enrich the learning environment.

14. Help to equalize opportunities to learn, especially for disadvantaged students.

15. Make teaching and learning livelier and more effective.

16. Prepare students for the school to work transition.

17. Provide access to re-skilling and life-long learning opportunities for disadvantaged groups in the community.

18. Promote the development of a stronger national/regional identity as well as sense of social responsibility in the information age.

19. Promote developments in curriculum, pedagogy and assessment to encourage the development of thinking, communicating, independent learning skills and creativity.

Categorisation of ICT Objectives

- Student & learning: 1,3,4,6,8,9

- Teaching and Pedagogy: 2,5,10,13,15,19

- School administration: 7, 11,14

- Educational philosophy: 12,16,17,18

Findings

- Ranking: *Most important* → *Less important*

- *6,1,(4,9),5,3,10,12,7,2,8,15,13,19,16,17,11,14,18*

- 6: Enable students to learn in a more independent way and to engage in life-long learning.

- 1: Enable students to make use of IT in their learning.

- 4: Broaden our students' mind by opening up a world of information to them.

- 9: Enable students to acquire self-learning skill and foster their creativity.

- 11: Facilitate school administration.

- 14: Help to equalize opportunities to learn, especially for disadvantaged students.

- 18: Promote the development of a stronger national/regional identity as well as sense of social responsibility in the information age.

Which ICT objectives are included present time:
(a) in most HK schools by ICT-literate teachers?

Objectives: 1,2,3,4,10,6,(9,11,15),(5,8),12,19

1. Enable students to make use of IT in their learning.

2. Facilitate new teaching approach and innovative classroom activities which cannot be achieved without IT devices.

3. Enable students to use IT devices.

4. Broaden our students' mind by opening up a world of information to them.

10. Facilitate teaching and learning process

6: Enable students to learn in a more independent way and to engage in life-long learning.

(b) in some HK schools by ICT-literate teachers?

Objectives: 7,(5,11,15),9,(4,8,10),(1,13,16)

7:     Facilitate educational innovation and improve quality of education.

5:     IT Education aims at fostering students' creativity and learning of academic subjects.

11:    Facilitate school administration.

15:    Make teaching and learning livelier and more effective.

9:     Enable students to acquire self-learning skill and foster their creativity.

(c) in no HK schools, to my best knowledge?

Objectives: 14,17,18,19

14:   Help to equalize opportunities to learn, especially for disadvantaged students.

17.   Provide access to re-skilling and life-long learning opportunities for disadvantaged groups in the community.

18.   Promote the development of a stronger national/regional identity as well as sense of social responsibility in the information age.

19.   Promote developments in curriculum, pedagogy and assessment to encourage the development of thinking, communicating, independent learning skills and creativity.

Which ones are you aiming to integrate into your teaching?

Objectives: 9,6,5,4,(15,1),(3,7),(2,19),8

9:    Enable students to acquire self-learning skill and foster their creativity.

6.   Enable students to learn in a more independent way and to engage in life-long learning.

5.   IT Education aims at fostering students' creativity and learning of academic subjects.

4.   Broaden our students' mind by opening up a world of information to them.

15.   Make teaching and learning livelier and more effective.

1.   Enable students to make use of IT in their learning.

Future Research

- Implementation of ICT objectives in HK schools
- Types of intended ICT objectives implemented? Achieved objectives (outcome).
- Extend to the research to instructional ICT objectives of teachers: behavioural & cognitive types
- Matching the ICT objectives between
  - administrators, teacher, students
  - curriculum
  - lesson planning
- Significance for learning/teaching environment?
- Matching strategies?