Knowledge building in project-work: social and affective aspects

- The advent of Information Technology (IT) Age

- IT accelerates the information transmission rate and the knowledge renewal cycles

- The demands on citizens are very different in the information age
  - lifelong learning
  - information mastering skill
  - creativity
  - problem-solving ability
  - technological literacy
  - skills for working in a team

Background — Government Level

- educational policy announcements

1996	The U.S Government announced a plan which all school would be linked virtually by network., titled “the information highway by the year 2000”
1996	The Denmark, Japan, Finland, Netherlands, Portugal and Spain governments adopted a set of new educational policy objective
1997	The Dutch Government established the teacher training institutes to prepare the teachers for the “school of the future”
1997	The Singapore Government launched an IT in education implementation plan
1998	The Hong Kong Government issued a five-year plan for integrating information technology across the curriculum
2000	The Hong Kong Government released a consultation document titled “*Learning to Learn: the way forward in curriculum development*” in which a new curriculum framework was proposed

- a significant change of the nature of the education goals and the level of demand to students
- a focus shift from cognitive to metacognitive in nature
  - Metacognition: knowledge, control & thoughts about learning
- in the "*Hong Kong Information Technology for Quality Education: Five Year Strategy*"
  - the aims and purposes of education are to enable students to

    "*have higher motivation to learn; have broader horizons and develop a creative mind through exposure to a wide range of knowledge and perspectives; develop habits of independent lifelong learning and team spirit*"

- schools try to realize the education plan and achieves the newly emphasized goals

- new pedagogical practices which involves:
  - new curricula
  - innovative ways of organizing teaching and learning
  - new roles of teachers and students
  - new assessment criteria

- this suggests the whole education scenario is undergoing a radical change

• An international comparative study, *SITES* (*Second International Information Technology in Education Study*) (1999) confirmed that there is a promising start of the paradigm shift in education:

"traditionally important paradigm" (the industrial society) → "emerging paradigm" (the information society)

• At classroom level, collaborative project work have emerged as a popular pedagogical approach.

•SITES (data collection period: 2000-2001)

•In Hong Kong, number of project-work cases: 9 out 14

• These project work is distinct with the project work in traditional sense in 3 ways:

(1) the duration: extended from 1-2 weeks to 1-4 months;

(2) students can select the theme they would like to work on and they have high level of autonomy throughout the whole process

(3) teachers have to provide formative assessment instead of just giving a grade at the end of the project

• Students therefore have the chances to improve their work.

The ThinkerTools Inquiry Project (UC Berkeley)

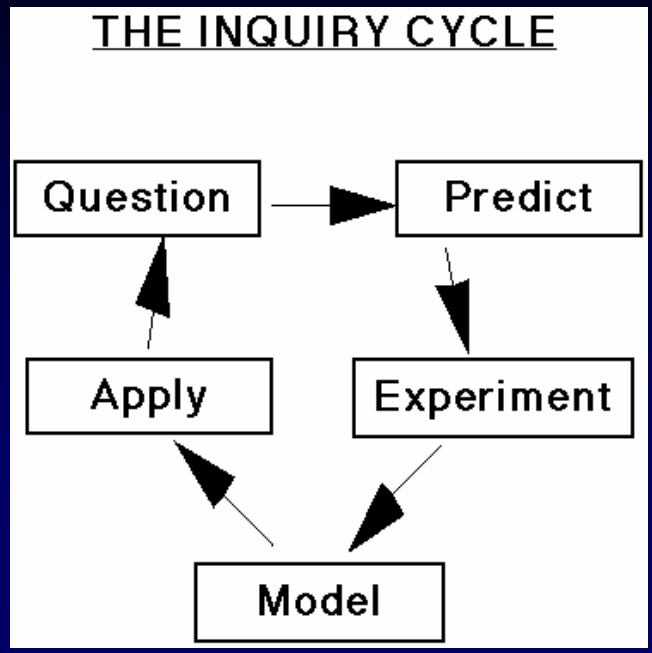
aims at exploring ways of developing student metacognitive skills through scientific investigation

2 components:

- the classroom implementation component
- the web-based environment

- the teacher leads students:
  - work in teams
  - make use of a web-based environment
  - interact with others and going through the processes of scientific inquiry
  - make use of a web-based environment, ThinkerTools
  - go through the 5 stages of the scientific inquiry process as researchers do

IT-Supported Inquiry-based Learning



(Adopted from White & Frederiksen, 2000)

- "what happens to the motion of an object that has been pushed or shoved when there is no friction or gravity acting on it?"
- put prediction on the web-based environment
- test their hypothesis
  - computer modeling tool provide by ThinkerTools
  - laboratory work
- apply their models
- new question emerges

ThinkerTools leads students to evaluate themselves, using a set of criteria:

(1) understanding the main ideas

(2) understanding inquiry process

(3) being inventive

(4) being systematic

(5) reasoning carefully

(6) using the tools of research

(7) teamwork

(8) communicating well

(1) inquiry-based learning which emphasized reflection is a viable way for metacognitive development

(2) the discussion and reflection at each stage of the inquiry cycle would be very important

(3) a positive classroom climate can empower students' learning in the inquiry process

(4) teachers can provide a positive environment by:

(1) encouraging student engagement

(2) giving encouragement

(3) developing good rapport with students

(4) respecting students

(5) being sensitive to students' differences

IT-Supported Inquiry-based Learning

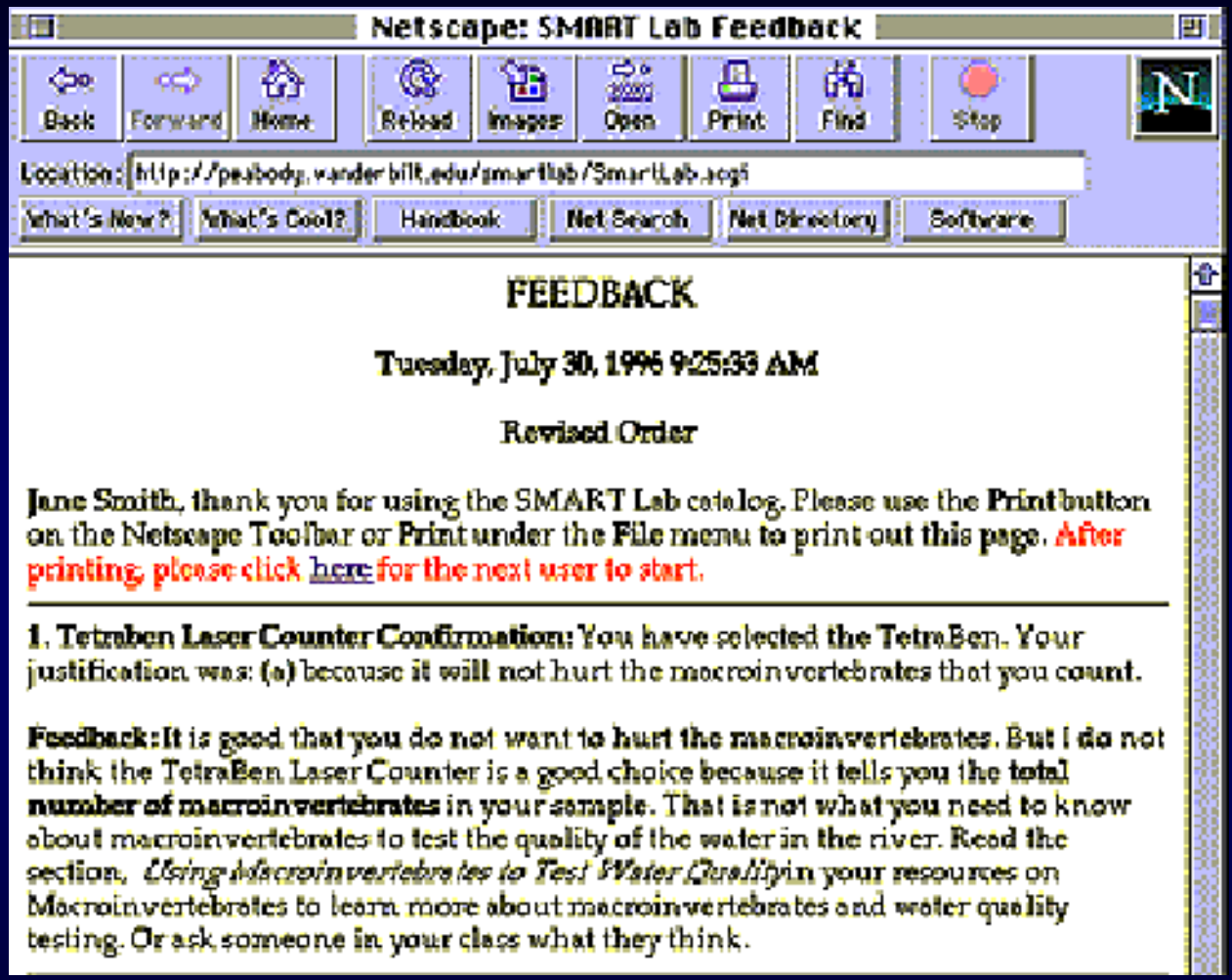
- JASPER Project & SMART Environment (University of Vanderbilt)
- aim at developing students' metacognitive and problem solving skills
- Jasper
  - a series of video materials
  - a set of rich data of a situation and end with an ill-structured questions
  - students have to work in groups and explore answers
- SMART, the Special Multimedia Arenas for Refining Thinking
  - can incorporate into the Jasper project
  - provides prompting questions according to the Jasper project that the students are working on

IT-Supported Inquiry-based Learning

- students working on a project about water pollution

- SMART shows a picture of a tool for assessing the quality of the water

IT-Supported Inquiry-based Learning



•SMART will generate a feedback to the students according to their choices

IT-Supported Inquiry-based Learning

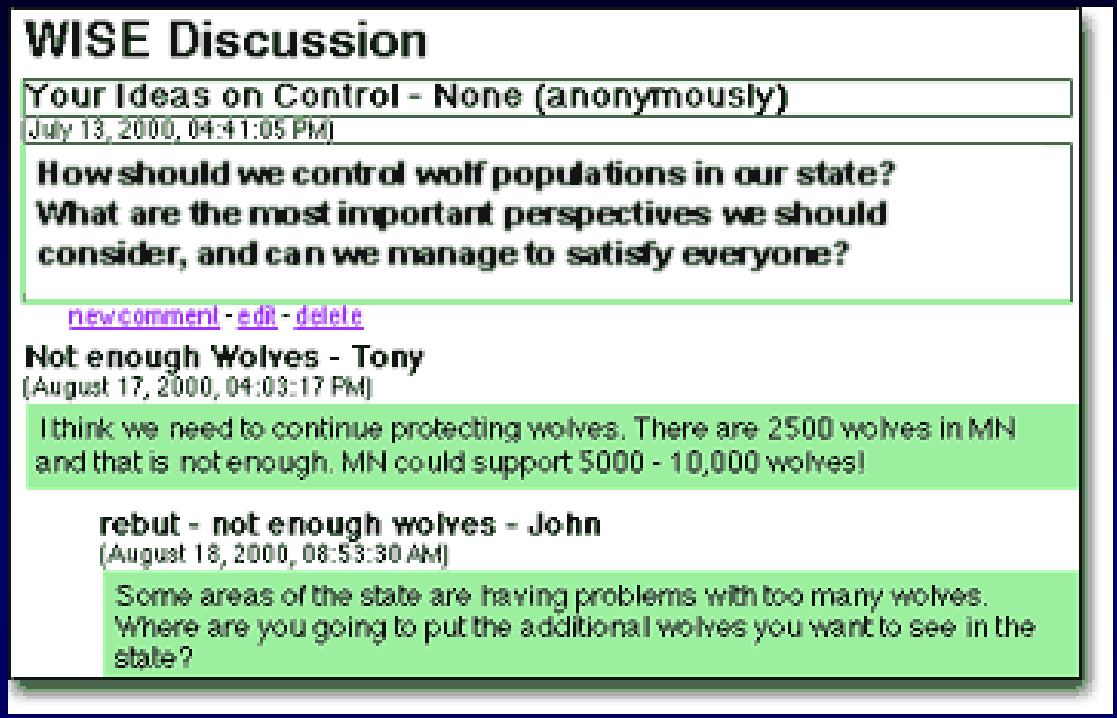
- students and teachers to read the thoughts of other groups
- importance of work in groups and learning from others' work
- learning through tackling an ill-structured questions which may allow various answers

IT-Supported Inquiry-based Learning

- WISE, Web-based Inquiry Science Environment (UC Berkeley)
- on-line science learning environment
- students work on inquiry projects such as “What makes plants grow?”
  - try to explore the answers
  - read the information
  - answer the prompting questions
  - Hints and notes
    - to reflect
    - to use the different tools
      - data visualization
      - causal modeling
      - simulations

IT-Supported Inquiry-based Learning

WISE



- on-line discussion
- interaction is encouraged

IT-Supported Inquiry-based Learning

- CSILE (Computer-Supported Intentional Learning Environments) (Ontario Institute for Studies in Education of the University of Toronto)
- to support and develop knowledge-building Community
- Knowledge-building:
  - a group of individuals
  - treat knowledge as artifacts reside outside people's mind
  - share and contribute to the advancement of the knowledge

IT-Supported Inquiry-based Learning

Knowledge Forum (the latest CSILE online network)

- support the students to construct knowledge and aware of their understanding, for example, by prompting the students to think of:

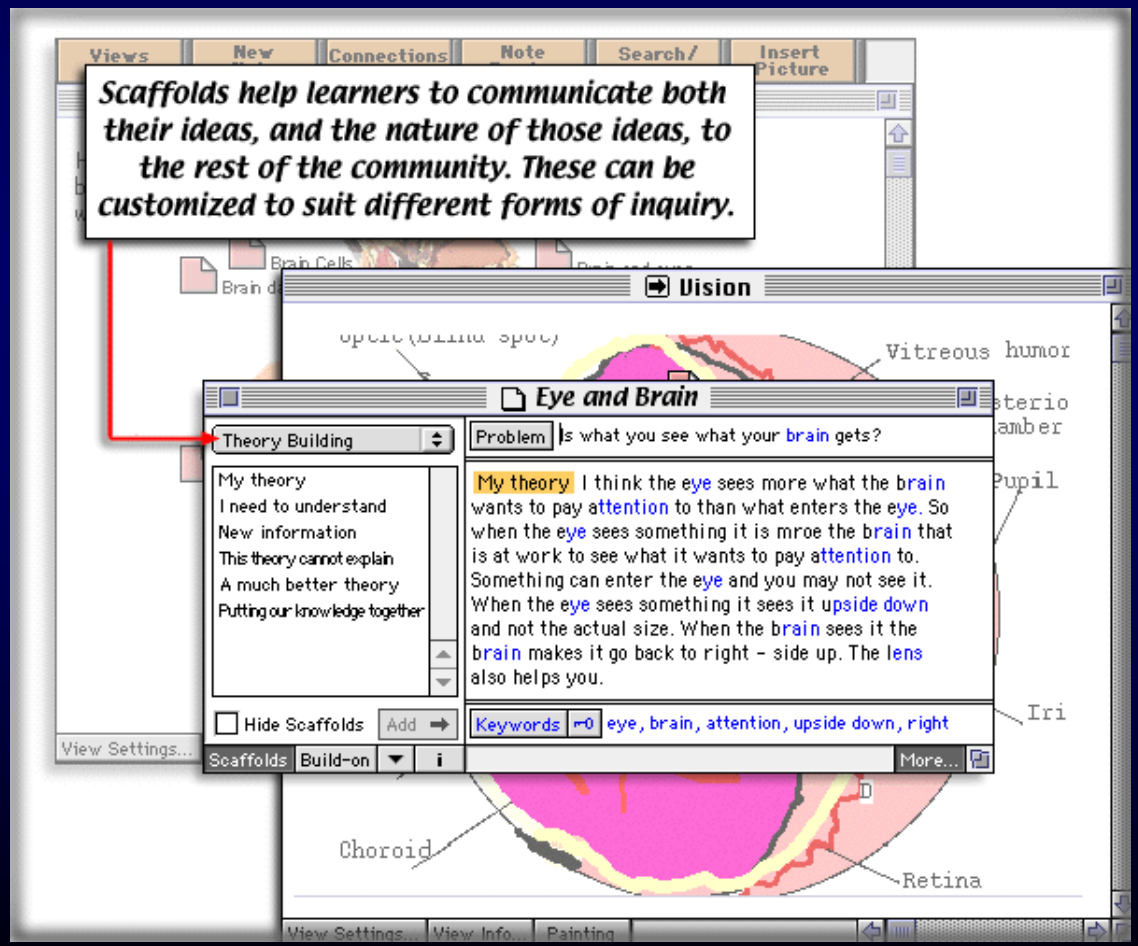
My theory...

I need to understanding...

New information...

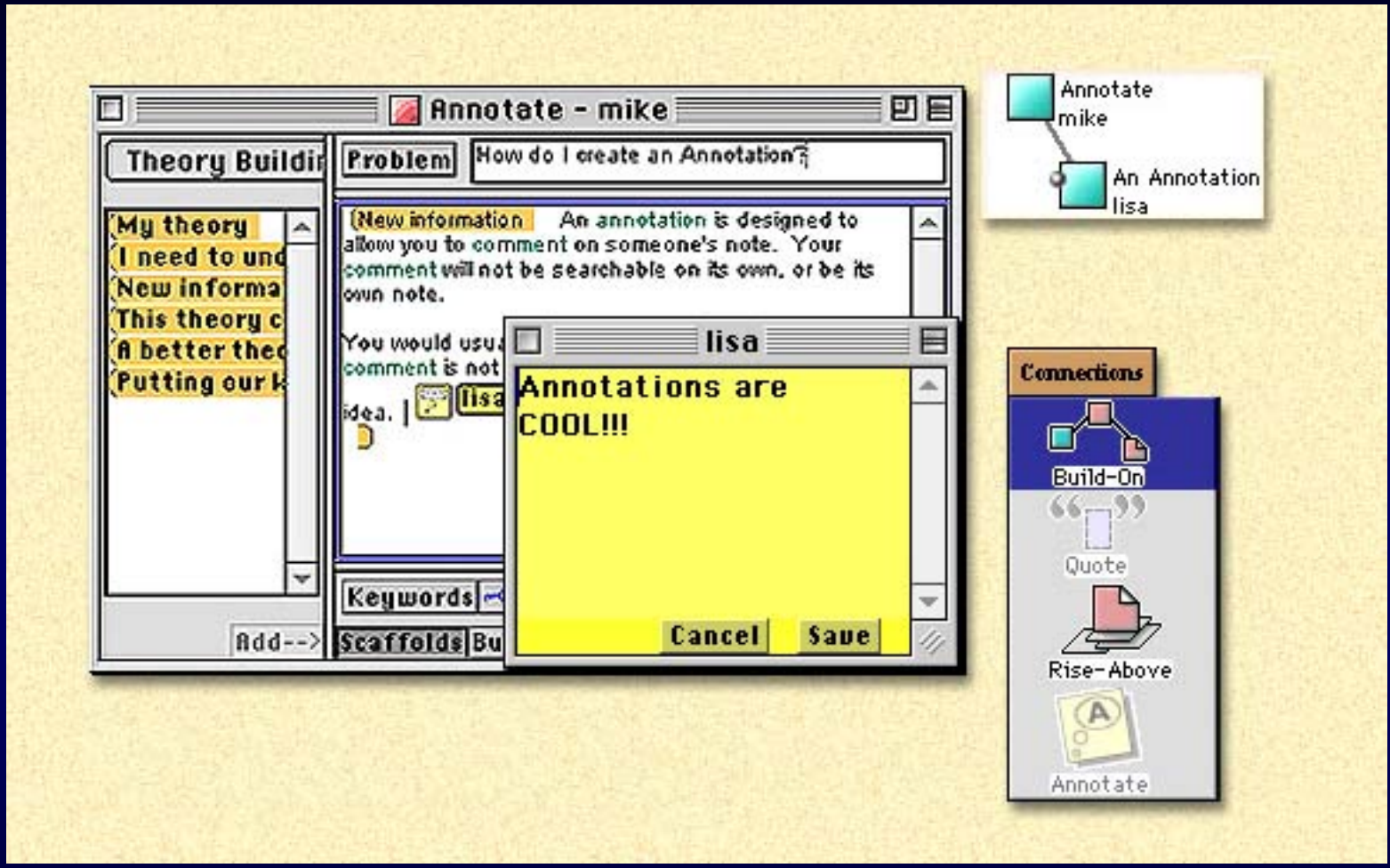
The theory cannot explain...

A much better theory...



IT-Supported Inquiry-based Learning

CSILE



- the users can store notes, connect ideas, and “rise-above” previous thinking
- the users in the community can connect their ideas together

IT-Supported Inquiry-based Learning

- SLITS (Self-directed Learning with Information Technology Scheme) (The University of Hong Kong)

- aims at investigating collaborative project work
- 40 groups of students (4 students per group) (different schools)
- working on projects of their own choice
- each group being facilitated by a teacher

IT-Supported Inquiry-based Learning

- An IT-supported environment is designed for the students
  - to communicate within or across the groups
  - to provide scaffolding to the groups by asking them some guiding questions

Stage 1: Problem exploration
  Which is/are the most important questions (s)? Why?
  Which question (s) cannot be answered by research? Why?
Stage 2: Problem refinement
Stage 3: Determine learning tasks and research methods
Stage 4: Data collection
Stage 5: Data analysis and processing
Stage 6: Publish findings

IT-Supported Inquiry-based Learning

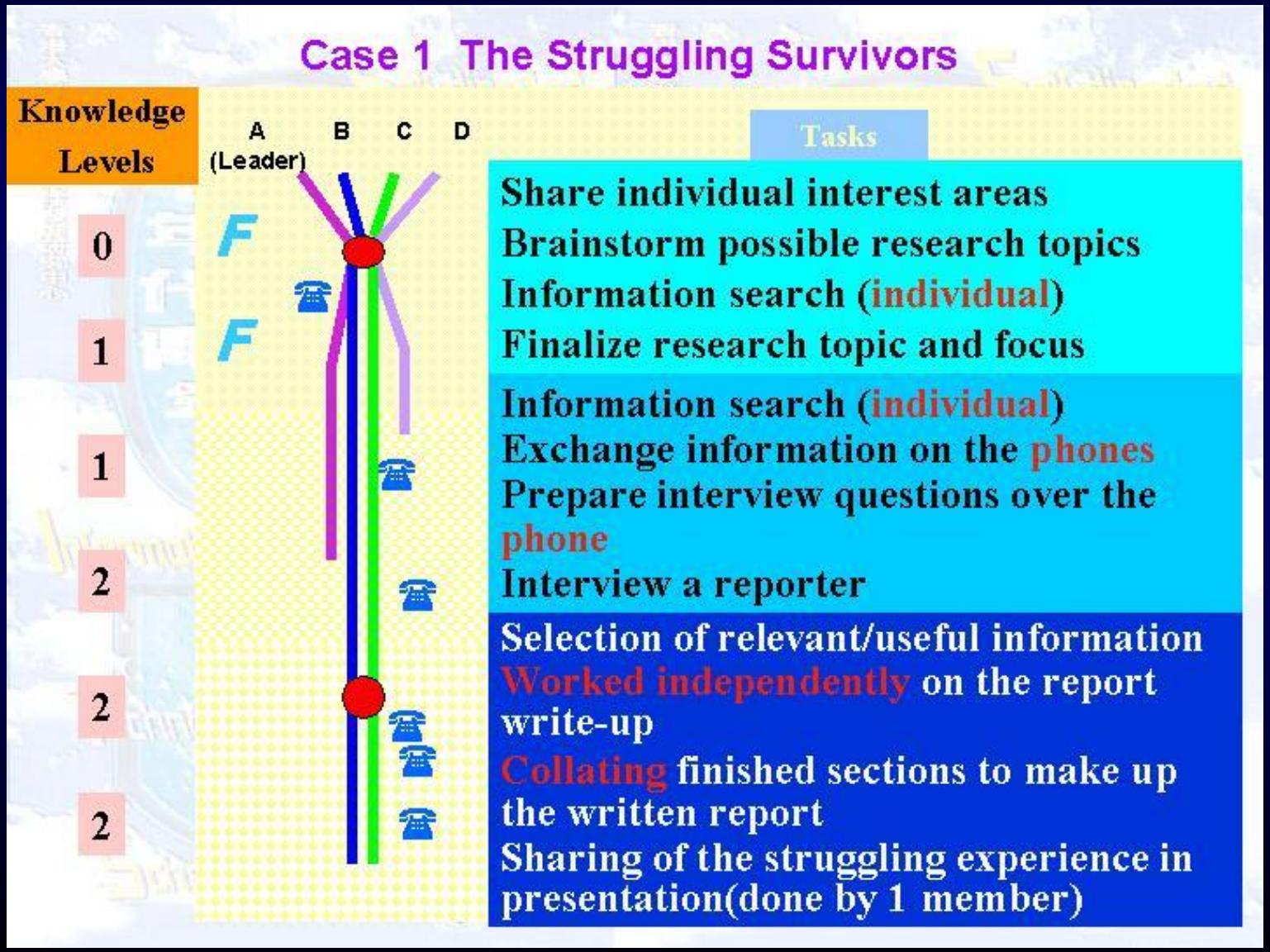
- Case studies of 3 groups (Law, Ma & Yuen, 2000):
- 3 kinds of interacting pattern:

1. “the struggling survivors”
   - drop-out of 2 members
2. “the happy collaborators”
   - looked for the common ideas
3. “the deeply interactive collaborators”
   - exhibited high collaboration
   - negotiation and integration of ideas
   - critique each other’s work
   - change in their understanding of the topic:rebellious behavior

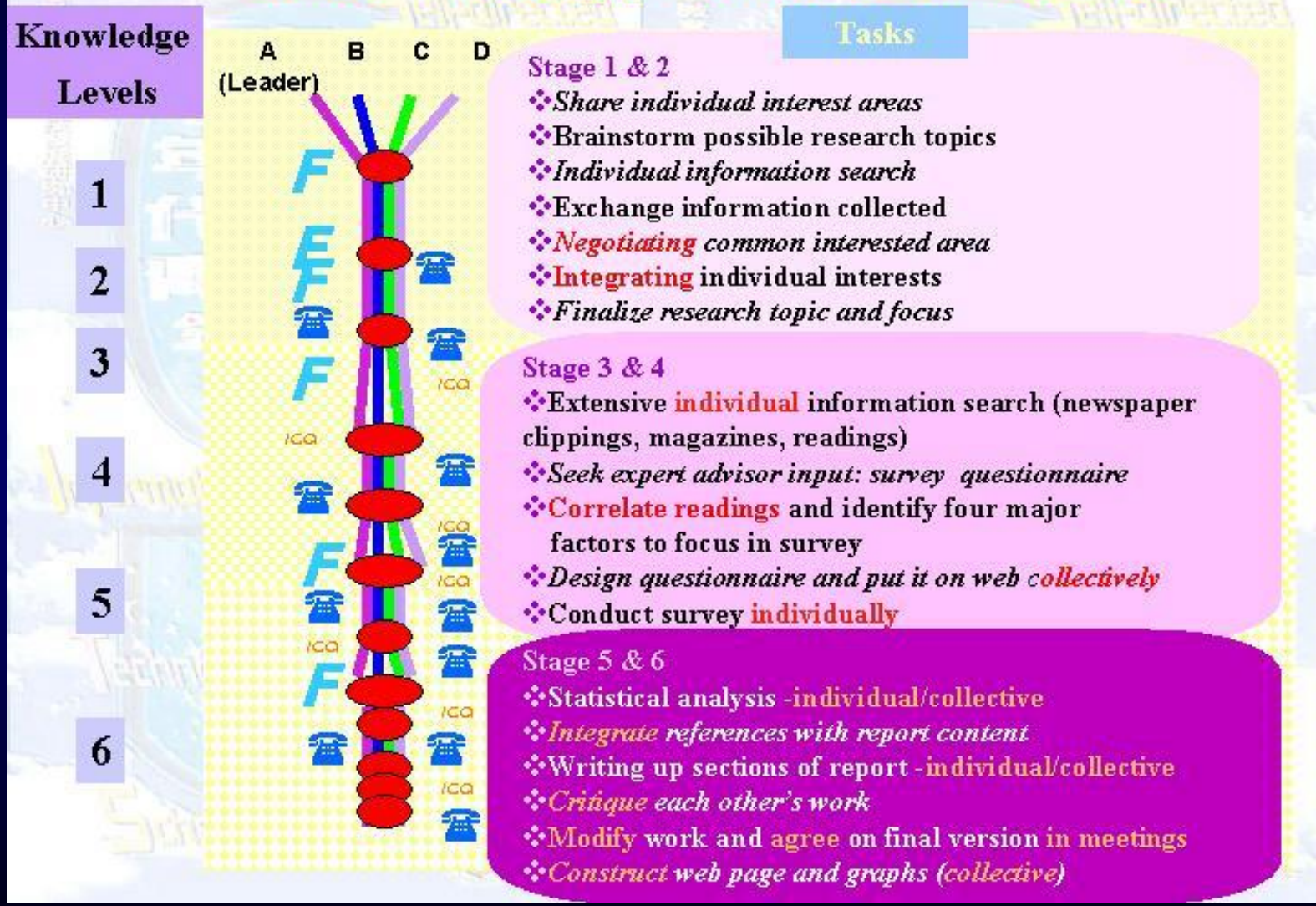
“ unapproved, inappropriate behavior ” ↓

form of normal and natural manifestation of one’s self-exploration and identity building behaviour in his/her growing process

- Cooperation and Collaboration



Case 3 The Deeply Interactive Collaborators



• the social and affective factors of the group members are intertwining and interacting, as shown by how they label the group, such as “happy (affective) collaborators (social)”

• only those groups in which the students continuously engage in interactive decision making during the learning process would lead to collaborative knowledge building

IT-Supported Inquiry-based Learning

Tasks:

- inquiry-based learning which emphasizes reflection is a viable way for metacognitive development
- learning through tackling an ill-structured question which may allow various answers

Teachers' facilitation:

- the discussion and reflection at each stage of learning would be very important

IT-Supported Inquiry-based Learning

Social Aspect:

- importance of work in groups and learning from others' work
  - classroom/online
  - inter-group & intra-group

Affective Aspect:

- a positive classroom climate can empower students' learning in the inquiry process

- The social and affective factors are intertwining and interacting

Professional Education

- Research focus: more on teacher's role

- The jobs and problems that the profession practitioners, such as lawyers or doctors are ever changing and not straightforward

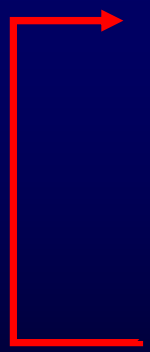
- Professional education has been facing the challenges of helping the students to develop the skills for life-long learning and problem solving

- Schon (1987) argues that professional education should be centered on enhancing the practitioner's metacognitive ability

Professional Education

A study of Schon (1987), which investigate how the students majoring in Counseling learn through coaching:

- Group discussion is important
- during group discussion:
  - some students are less willing to take risk when applying theory
  - the willingness to confront with others' ideas affects the depth of discussion



instructor should intervene

- the main task of the instructor is to create and sustain a process of collaborative inquiry

Life-world Knowledge & Critical Inquiry

•Science Education

•To distinguish “Life-World Knowledge” from scientific knowledge

• can be extended to other disciplinary knowledge

Life-world Knowledge & Critical Inquiry

Life world knowledge	Scientific Knowledge
• Social exchanges try to achieve a mutual understanding and agreement	• The aim of debate is to sharpen differences and to confirm or refute rival opinions
• Words used have multiple meanings which are not defined but negotiated socially	• Concept words are unambiguously defined for exact use
• Meanings are dependent on the cultural group and on the physical or affective context	• Concept meanings are symbolic and abstracted from any particular situation
• Apparent contradictions are tolerated. No logical method is thought to be needed	•A tight logical network of concepts and theories is claimed.
• This knowledge system is well socialized by daily use with familiar people	• This knowledge is not well socialized since its methods are rarely used and then only by teachers outside the peer group

Metacognition & Knowledge Building Process

- Metacognition: knowledge, control & thoughts about learning
- in Flavell's words, '*knowledge and cognition about cognitive phenomena*.' (1976)
- there are different levels of metacognitive competence, according to the nature of the cognitive activities it associated
- Researches investigating metacognition were first conducted by developmental psychologists in 1970s
    - Metamemory
    - Metacomprehension
    - Schema training
    - Executive control
    - Self-Regulation
    - Transfer

Metacognition & Knowledge Building Process

- metacognition associated with the knowledge building activities
- knowledge building
  - not treating knowledge as something in minds but an artifact which everybody can change and contribute to it
  - students are highly responsible for contributing to the common knowledge of their group/class/community
  - students are working just as researchers do, though what they work on may not be as advance as the researcher's

Metacognition & Knowledge Building Process

Knowledge building activities vs. traditional-chalk-and-talk classroom

- what is going to be learnt was not predetermined by the teacher and it is an outcome of the joint effort of the students
- Students' participation instead of teacher's talk
- students' learning can go beyond disciplinary knowledge and achieve some higher level development, such as
  - their perception towards learning
  - their understanding of themselves as a learner

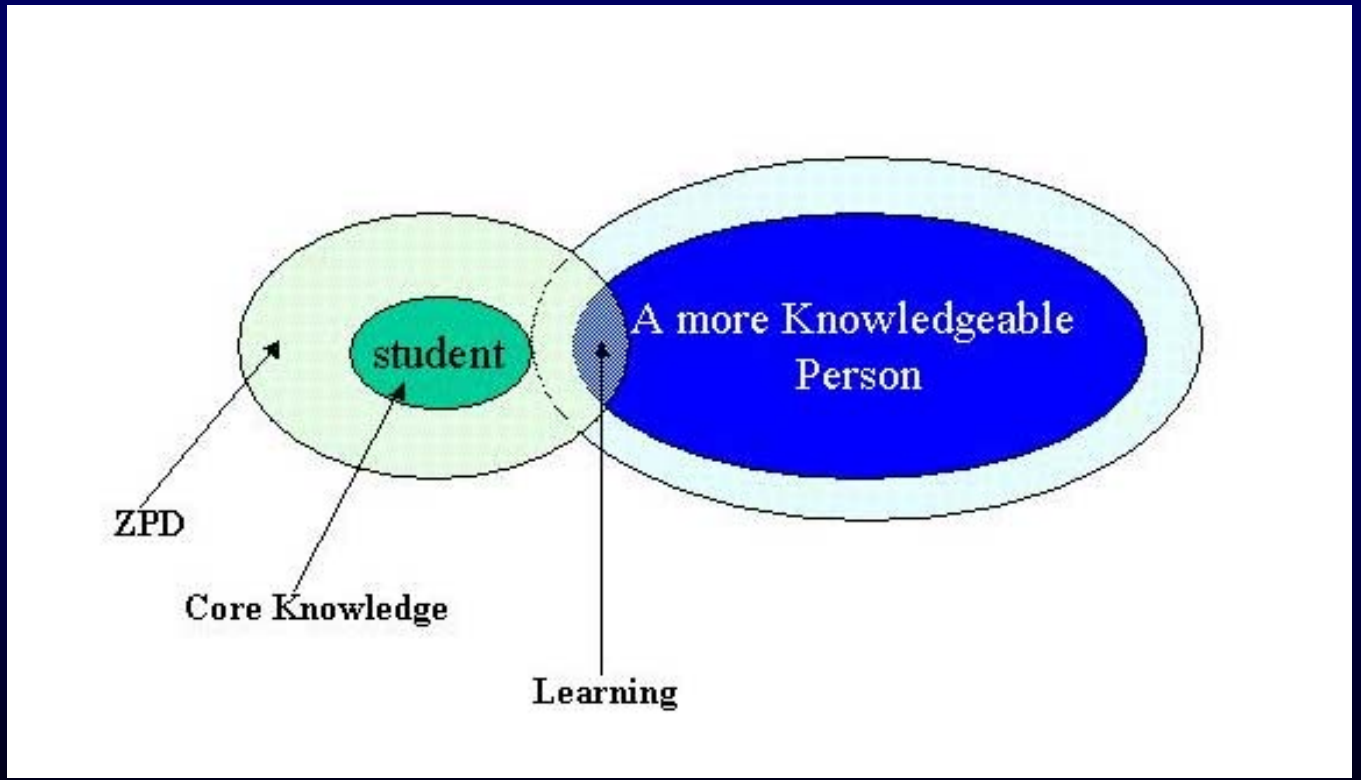
Metacognition & Knowledge Building Process

The Level of Approach to Knowledge Scheme (Bereiter & Scardamalia, 1999)

LEVEL 0:	Knowledge as equivalent to "the way things are"
LEVEL 1:	Knowledge as individuated mental states. Children realize that one person may know something that another does not
LEVEL 2.	Knowledge as itemizable mental content
LEVEL 3.	Knowledge as representable.Knowledge is something to be represented, shared and interpreted by others
LEVEL 4.	Knowledge as viewable from different perspectives. Students see that the same knowledge can appear in different contexts and can be viewed from different perspectives. **This is an important step toward objectification.**
LEVEL 5.	Knowledge as personal artifacts. Viewing oneself as constructing knowledge is a large step beyond viewing oneself as constructing knowledge representations (LEVEL 3).
LEVEL 6.	Knowledge as improvable personal artifacts.
LEVEL 7.	Knowledge as semi-autonomous artifacts.

Social Aspect of Learning

- Vygotsky
- Zone of proximal Development
- scaffolding



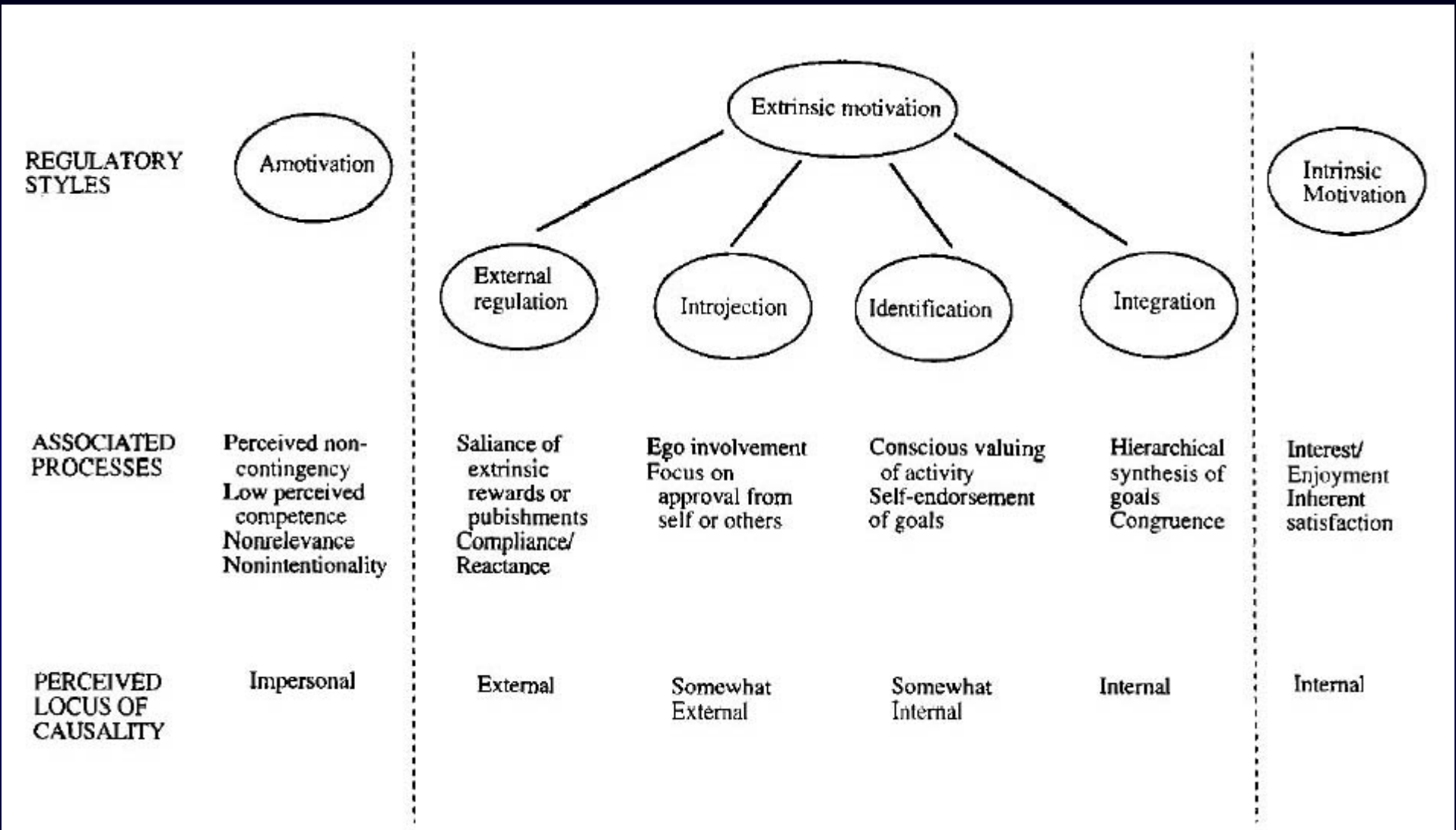
Social Aspect of Learning

- Vygotsky's vs. Bereiter's Perspectives
- Vygotsky's perspective:
  - optimal learning in group work would be the summation of the core knowledge of the members
- Bereiter's perspective:
  - knowledge not residing in mind
  - advancement of knowledge through knowledge building activities in a community

- Motivation: describe the source that a person is willing to do something

- Self-Determination Theory (Ryan & Deci, 1985)

  - take both personal and social factors into account



Self-Determination Theory: A Taxonomy of Human Motivation

- Sense of relatedness of students towards classes/teachers is important as this facilitate the internalization of values

- A sub theory of Self-Determination Theory: Cognitive Evaluation Theory

    - suggests a sense of autonomy of students is crucial for intrinsic motivation

Self Efficacy

- defined as personal judgement of one' capabilities to attain goals (Bandura, 1977)
- stresses the role of personal factors in explaining motivation
- there is evidence that self-efficacious students participate more readily, work harder, persist longer and have fewer adverse emotional reactions when they encounter difficulties (Bandura, 1997)

Expectancy-Value Theory (Eccles et al, 1993; Wigfield 1994; Wigfield et al, 2000)

- how well they will do in the activity and the extent to which they value

Goal Theory (Dweck, 1991; Ford, 1992)

- goal as the source of motivating students
- individual or collective goals

Self-Determination Theory is most preferable:

- a spectrum of motivation stages, instead of just categorizing students into 2 categories as the Self-Efficacy Theory does (efficacious and non-efficacious)

- take both social and personal factors into consideration

Affective Aspect of Learning

Academic Risk-taking

- Students are more willing to take risk in groups (Seung et al, 2002)

- In group, the feeling of shared responsibility make students feel less threatened by the consequences of failure

- Students are less willing to take risk when applying theory

Slits: the deeply interactive collaborators vs. the happy collaborators

in field of organizational team building, conditions for high quality consensus (Stump, 2002):

- Willingness to confront and resolve controversy and conflict
- Members willing to contribute their views and discuss their reason
- Commitment and effort to develop an atmosphere of honesty and openness in the group
- Sufficient time to explore all the information and opinions
- Strong facilitative leadership

Research Questions

- Does knowledge building necessarily result from engaging students in project work?
  - Can we distinguish different levels of approach to knowledge in knowledge building activities?

- What are the conditions influencing knowledge building in project work? Some dimensions for investigation could be:
  - Task
    - Task nature
    - Organization of the task
  - Role of teachers
    - Instruction: level of autonomy grant to students
    - Frequency of giving Intervention and instruction
  - Cooperation/collaboration among within the group and across the groups:
    - Cooperation/ collaboration pattern
    - Interaction of ideas (confront and consensus)
    - Frequency of communication

Research Questions

- About the students/group :
  - Motivation
  - Willingness to conflict/consensus
  - Risk taking behaviour (when applying or not applying theory)

Research Methodology

- by understanding the data collected in 7 case studies of project-based learning
- an exploratory qualitative approach
- 7 cases
    - From SLITS & SITES
    - Non-school & school settings
    - Primary & secondary level
    - Different subjects (science, Economics, General studies, interdisciplinary/cross-curriculum)

Research Methodology

Data

Cases	From	Level	Subject	Kinds of Data
1	SLITS	S.5	Interdisciplinary	•Group interim reports & video tapes of interim presentation •Group final report •Students' working journals •Students' interview •Facilitator's interview
2	SLITS	S.5	Interdisciplinary	• Group interim reports & video tapes of interim presentation • Group final report •Students' working journals •Students' interview •Facilitator's interview

Research Methodology

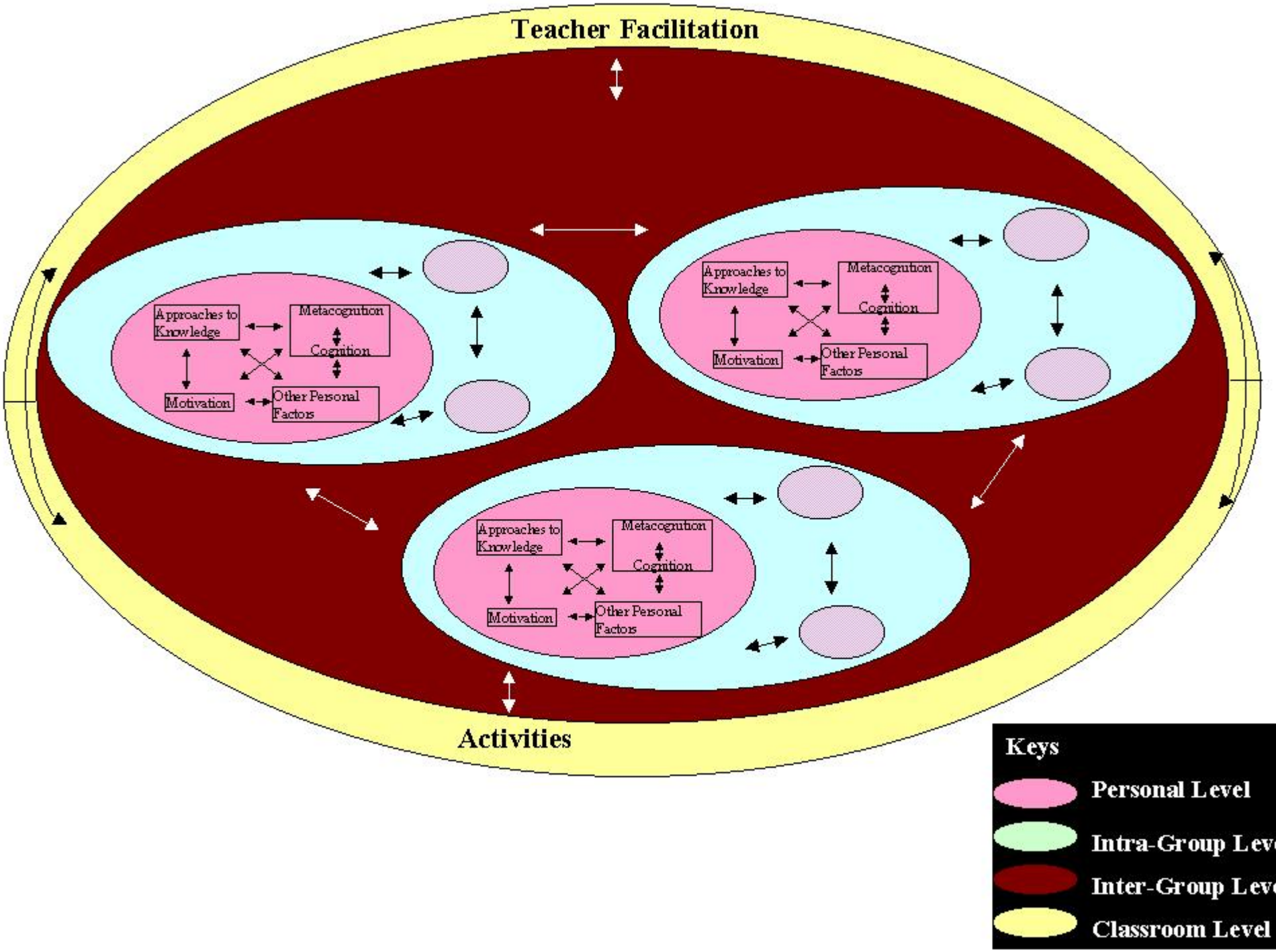
Data

Cases	From	Level	Subject	Kinds of Data
3	SLITS	S.5	Interdisciplinary	•Group interim reports & video tapes of interim presentation •Group final report •Students' working journals •Students' interview •Facilitator's interview
4	SITES	P. 4	General Studies	•Video tapes of lessons •Video tapes of interim presentation •Video tapes of students' presentation •Initial and interim written work of students •Final report of Students •Teacher's interview •Students' interviews

Research Methodology

Data

Cases	From	Level	Subject	Kinds of Data
5	SITES	P. 6	Interdisciplinary: General Studies Chinese language Mathematics Moral Education	• Video tapes of lessons •Teacher's interview •Students' interviews •Websites developed by the students which including their reflection
6	SITES	F 4 & 5	Economics	•Video tapes of lessons •Video tapes of students' presentation •Final report of Students •Teacher's interview •Students' interviews
7	SITES	F.6	Science	•Video tapes of lessons •Final report of Students •Teacher's interview •Students' interviews


Teacher Facilitation
Approaches to Knowledge
Metacognition
Cognition
Motivation
Other Personal Factors
Approaches to Knowledge
Metacognition
Cognition
Motivation
Other Personal Factors
Approaches to Knowledge
Metacognition
Cognition
Motivation
Other Personal Factors
Activities
Keys
Personal Level
Intra-Group Leve
Inter-Group Leve
Classroom Level

Preliminary Analysis

Case 4

- Primary 4
- General Studies
- 4 months
- 40 Primary students
- topic: Understanding myself
  - select their research focus
  - design the questionnaires
  - carry out the process of data collection
  - analyze the data and compile the project report.

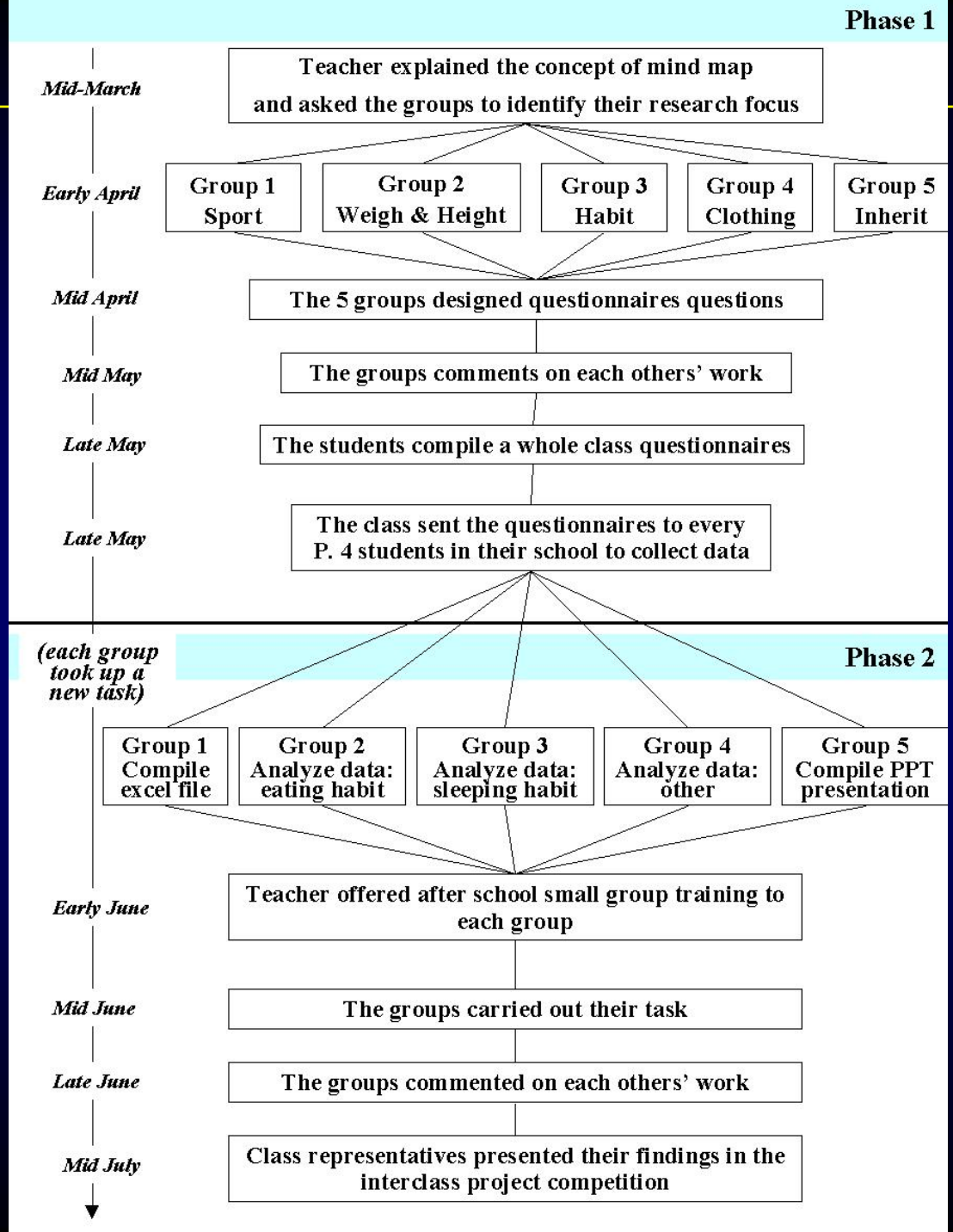
Case 6

- Secondary 3 & 4
- Economics
- 3 months
- 25 students
- a study trip to Shun Tak of Mainland China

Preliminary Analysis

Case 4

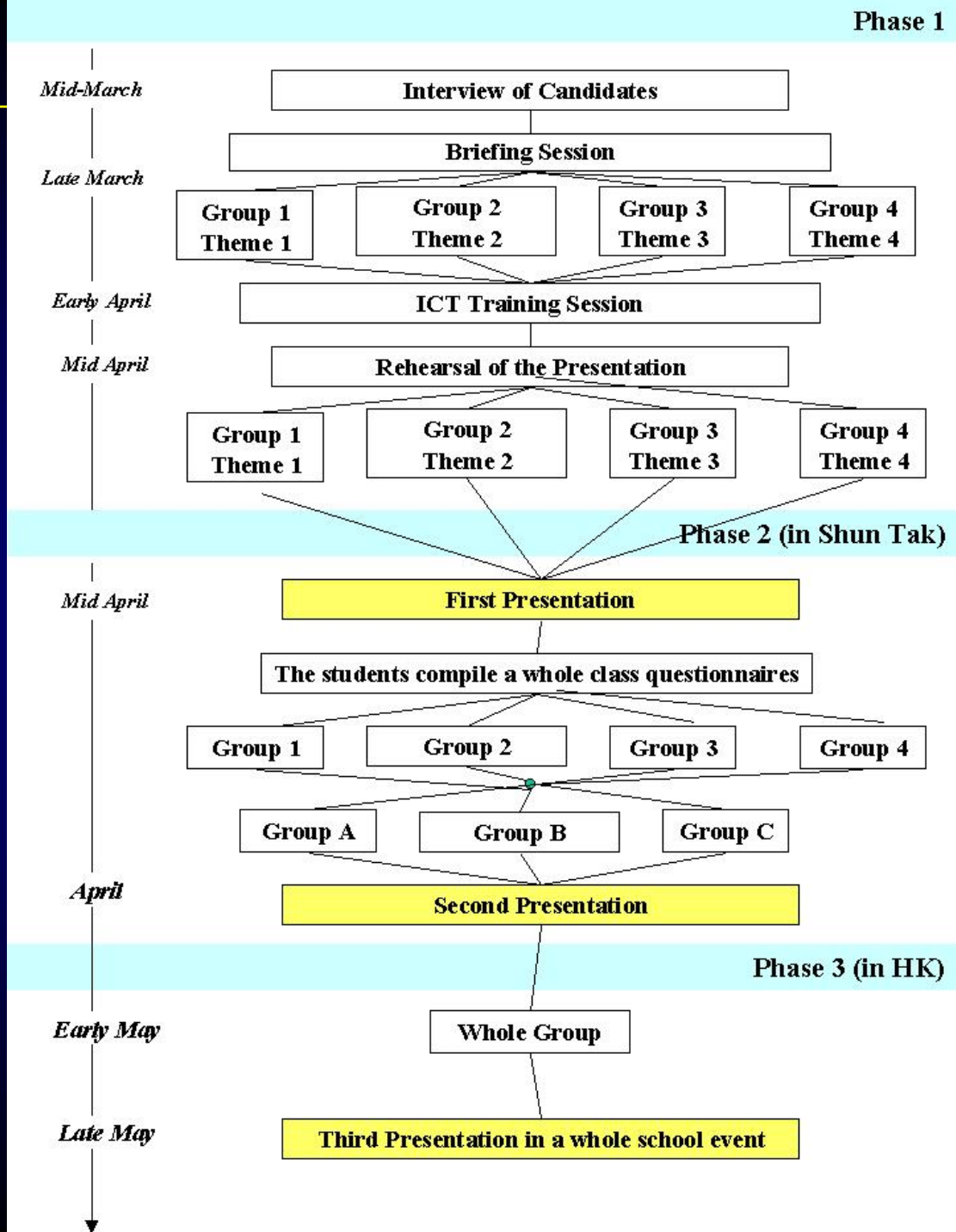
Task Flow



Preliminary Analysis

Case 6

Task Flow



Preliminary Analysis

Factors that motivate students:

Case 4

•the students have to participate in the annual inter-class project competition

•although the students were divided into 5 small groups, they had to compile their work to become the final project report. This created a tension between the groups, which made them seriously considered and actively commented on the strengths and weaknesses of other groups' work

Case 6

•the students knew they had to represent the school and present their report to the students in China

•there was a interviewing session which select the participants of the trips. The students expressed that they were proud of being selected.

Preliminary Analysis

Role of teachers

Case 4

• the teacher kept on reminding students that they had to participate in the competition and told the students the fun and value of project work. A students mentioned that she started to become aware the value of project work.

•an encouraging teacher who provide intensive small group facilitation to the students during lunchtime.

• She allowed the students to express themselves freely

Case 6

• provided intensive facilitation (rehearsal of presentation, modification of work…)

Preliminary Analysis

Other findings

Case 4

- In the students' interview, it could be found that most students commented it was enjoyable to work with their friends and work on their topic
- students mentioned that they were proud of their findings (feeling of ownership)

Case 6

- mixed groups of Form 4 with the Form 3 students, the groups had to take some time to get to know each other
- but later, the Form 4 students were motivated by the sense that they have the responsibility to take care of the Form 3 groupmates
- the first time for them to engage in an extended project work, in which they got intensive teacher's facilitation.They were amazed by recognizing what they could do and the depth of their understanding

What's Next?

- To analyze the interim reports of students, the lesson transcription and interview data in order to identify the changes of students' understanding
  - task flow
  - cooperation and collaboration pattern

- To identify the levels of approach of knowledge the students demonstrated
- the conditions influencing knowledge building in project work
- To complete all cases analyses and compare the cases