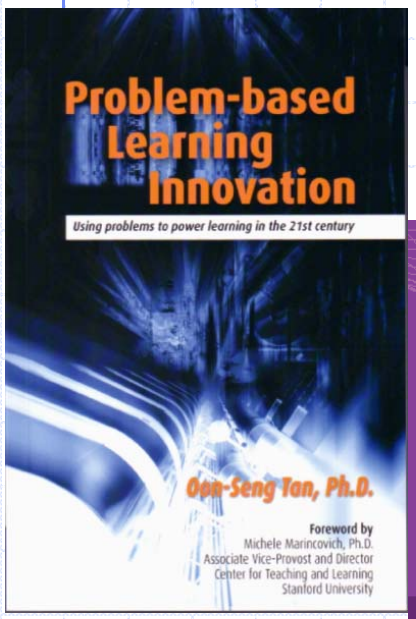
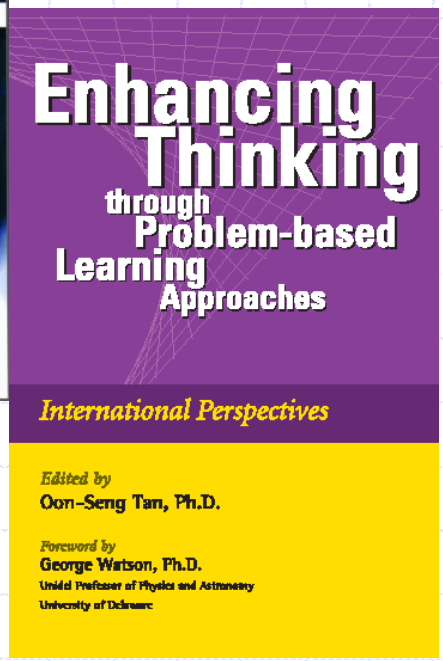
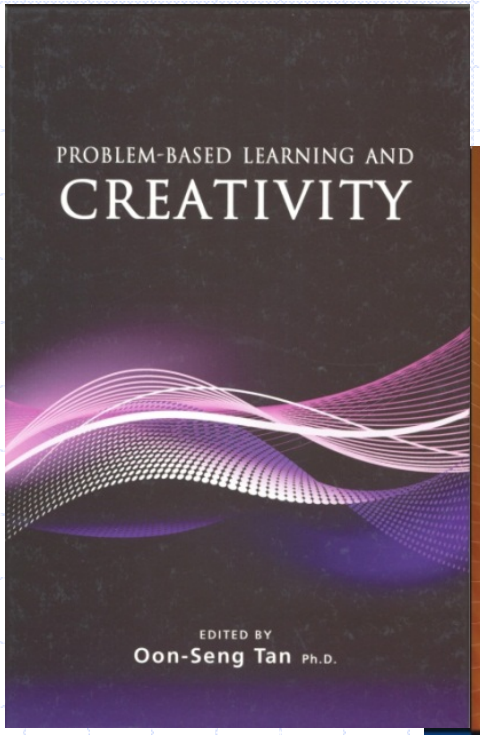
Enhancing Intelligences through Problem-based Learning Approaches

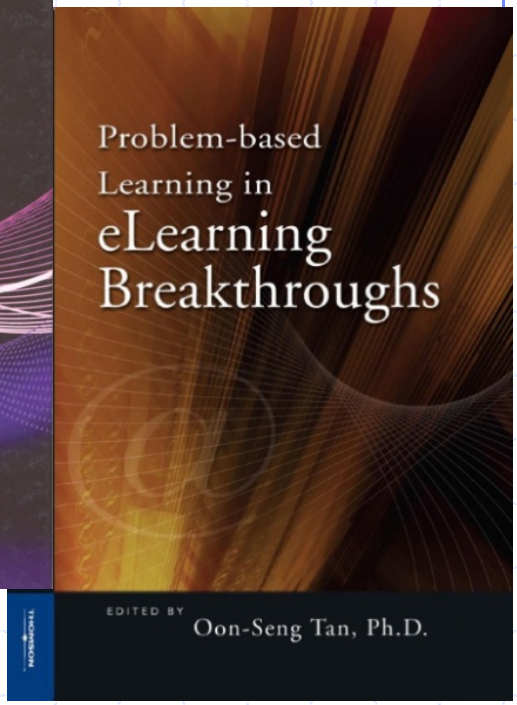
Professor Oon Seng Tan

Some Sources and References









Objectives

- To introduce problem-based learning (PBL) as a strategy to incorporate 21st century competencies
- To extend repertoire of learning and teaching approaches

Outline of Workshop

- Introduction to PBL
- Why PBL?
- PBL Experience
- Facilitation of PBL process
- Design of Problems

Ostan PBL Model: Address Changing role of teaching

- Engagement (Design of learning environment and design of problems)
- Deeper Understanding (Facilitation of cognitive thinking)
- Valued Outcomes (Diversification of learning outcomes, assessment of process)

Overview of Session

- 21st Education: Teach Less Learn More
- Why Use Problems?
- What is PBL?
- PBL Facilitation and Inquiry-based Learning
- Designing Problems
- Curriculum Development in PBL
- Questions and Discussions

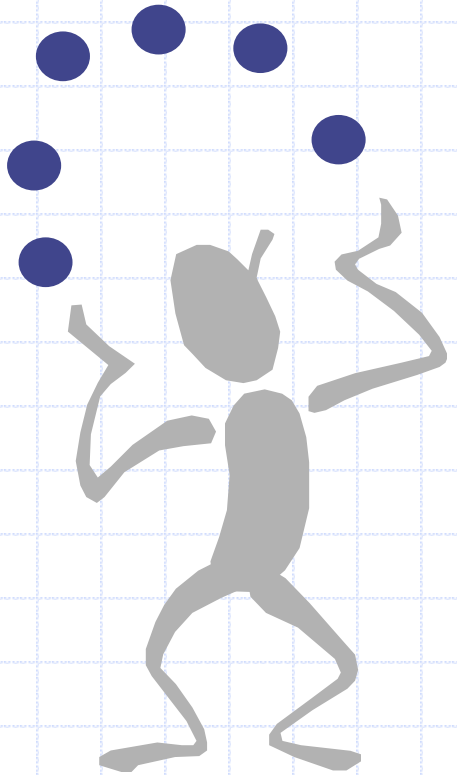
#1
21st Education: Teach Less Learn More

21st Century Challenges

- Problems of increasing quantity and difficulty
- Newer problems and shorter time frame for solutions
- More global problems requiring integrated solutions
- Harnessing of multiple intelligences, competencies and capabilities (IQ, EQ, etc)

21st Century Skills according to XN

- Problem Solving
- Teamwork
- Interpersonal Skills
- Creativity
- Project Management
- Systems Perspective



Key Dimensions of a more Creative System of Education

- Opportunities and Chances
- Spectrum of Talents and Abilities
- Maximising Individuals' Unique Potentials
- Initiative
- Enterprise
- Innovation

Multiple Intelligences

Nothing manifests the need for multiple intelligences more than the challenge of dealing with real-world problems.

Education in the 21st Century

- Developing intelligence is about a mindset of curiosity and learning to solve problems.
- Problem solving and inquiry in real-world contexts involves multiple ways of knowing and learning.
- PBL approaches involve harnessing intelligences
  - from within individuals,
  - from groups of people and
  - from the environment to solve problems
- Psychology of a Child: Problem-seeking, Curiosity, Inquiry, Discovery

Education is not just about preparing people for the future; it is also about inventing our future. Inventive mindset begins with curiosity and problem solving acumen

Educators today are not just disseminators of information or even facilitators. Learning has to extend beyond the physical boundary of the classroom and educators need to become ***designers of the learning environment***.

Important Educational Practices

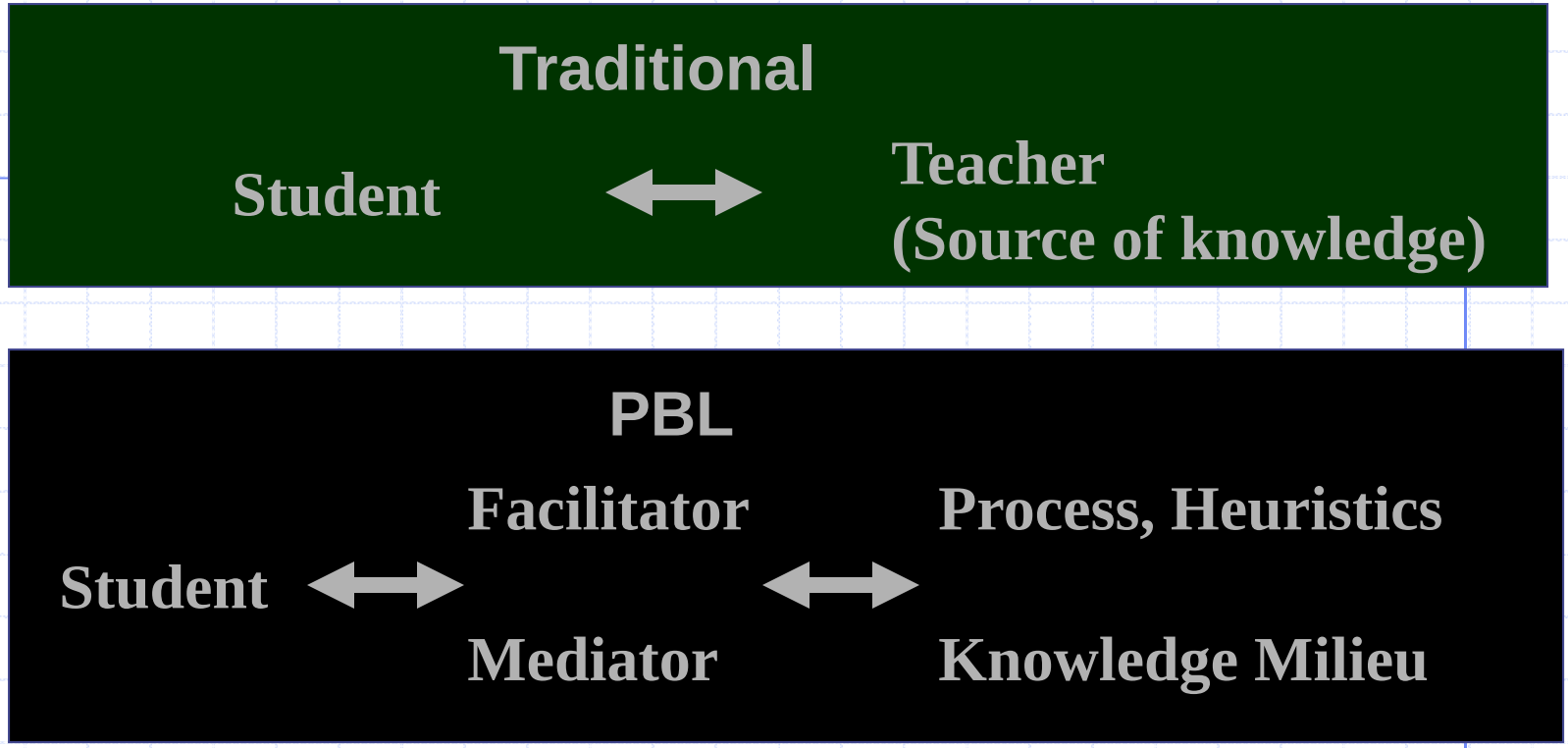
- Student-independent learning
- Information mining
- Use of real-world challenges
- Use of unstructured problems
- Contextualization of content knowledge
- Use of higher-order thinking skills
- Students defining scope and issues of learning
- Peer teaching
- Peer evaluation
- Teamwork
- Multidisciplinary learning
- Assessment of process skills

In the knowledge economy we need to learn to solve novel problems, to assume personal responsibility for learning, to learn collaboratively and from multiple resources, and to be able to transfer learning across disciplines and contexts.

Education in the KBE should involve:

- encouraging curiosity and discovery
- fostering lifewide learning (transfer of learning across contexts and disciplines)
- independent learning - assuming greater personal responsibility for one's learning
- learning how to learn from multiple sources and resources
- learning collaboratively
- learning to adapt and to solve problems (i.e. to cope with change)

Role of Facilitator-Mediator



Designer of the Learning Environment

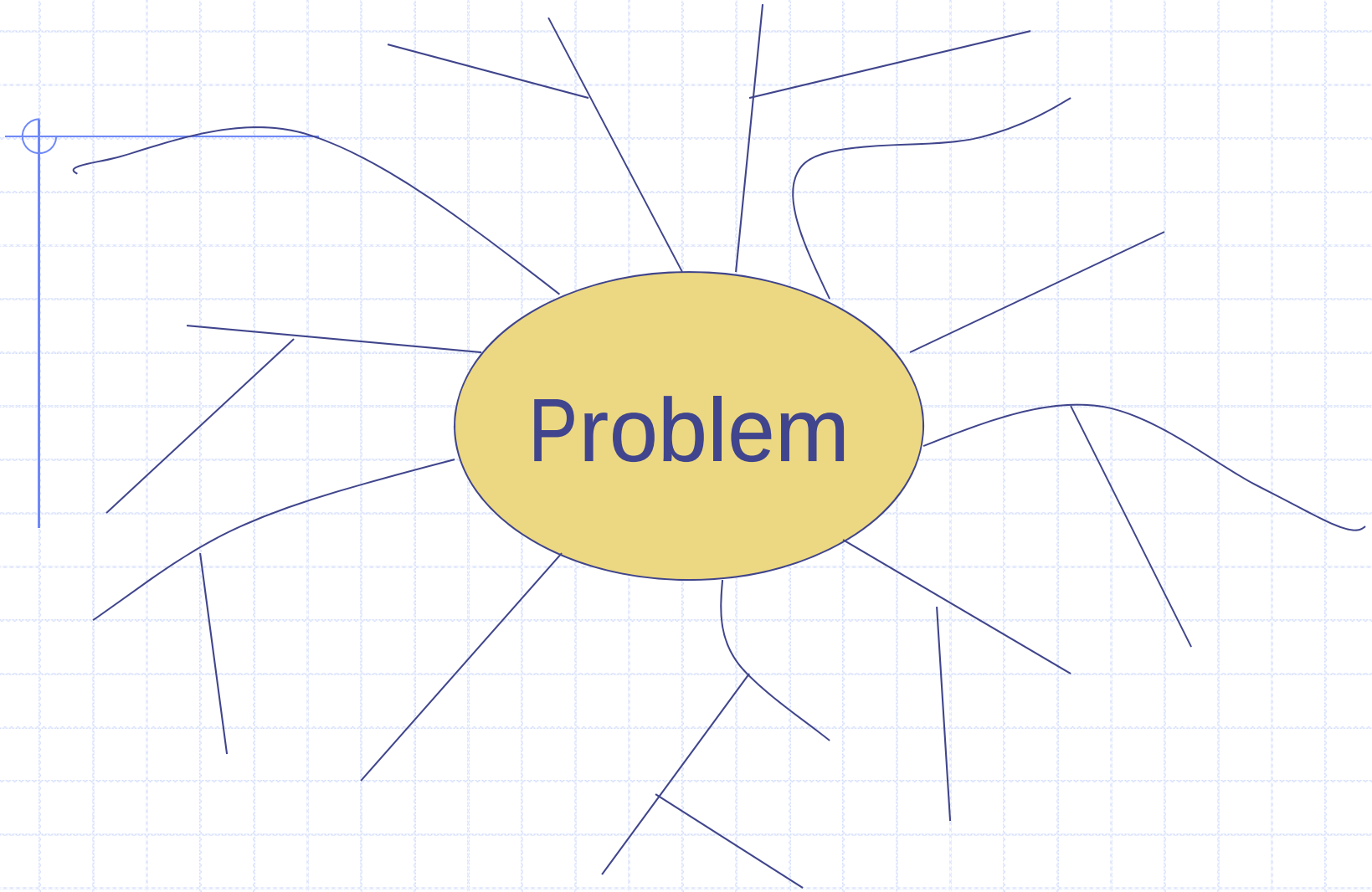
Self-Directed Learning Environment

Design of Problem or Problem Scenario

Student

Collaborative Learning Environment

#2
Why Use Problems?


Problem

The Psychology of the Use of Problems

- Problems: Fuzzy, Uncertainty, Challenging
- Real-World Problems vs Exercises (Routine, Not-so-routine, non-routine)
- Driving Force of
  - Motivation
  - Curiosity
  - Learning
  - Thinking
  - Collaboration

- HG Wells played with problems all his life – models and miniatures were his preoccupation.

Learning by playing

Children learn by creating problems and trying to solve them.

Children's play is about problem creation and discovery – engaging in solution but without worry.

See p. 78-79 of Tan (2003) on quote by Richard Feynman.

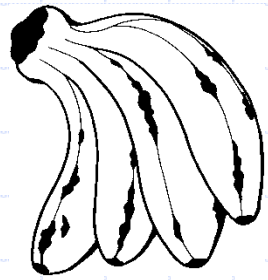
Children and ourselves learn by playing without worrying....

Great Ideas and Breakthroughs often begin with a fascination with problems (followed by *ownership* of the problems concerned)

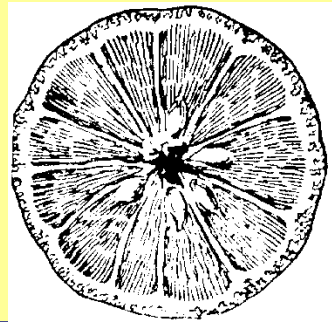
Life-saving discovery for Children...

- A doctor who played with paintings (Bacteria paintings) – pigmented bacteria on agar plates
- Alex got into trouble with the scientific community
- These painting led Alexander Fleming to discover Penicillin

Banana Problem



- Why does a banana turn brown when it is hit?
- This was a problem that got Albert Szent-Gyorgyi engaged...
- The biochemist discovered that there were two categories of plants
- Szent-Gyorgyi reasoned by comparing, classifying and connecting key information in biology and chemistry.
- He went on to discover biological combustion processes pertaining to Ascorbic acid (vitamin C)
- Nobel Prize in Physiology and Medical Science

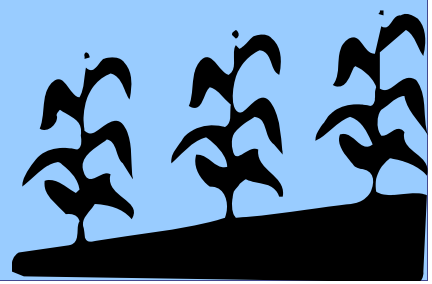


Exercise, Nature and Music

- A Japanese engineer wanted to have rich music, outdoor beauty and a walking exercise simultaneously.
- His preoccupation with the problem led to the first conception of Walkman - the tiny stereo with headphones.

Cornfield experiment

- Genetic experiment: Sterility of pollen from the corn. The researchers observed certain discrepancies (from what was expected but which most did not bother about).
- Barbara McClintock, however, took ownership of the problem. Decades later, she said: “When you suddenly see the problem, something happens....”
- Discovered mobile genetic elements that won her the Nobel Prize in 1983.



Problem and Spin-offs

- Osheroff, D. was a graduate student of David Lee and Robert Richardson at Cornell University.
- There were looking for “a phase transition to a kind of magnetic order in frozen helium-3 ice” but owing to Osheroff’s sharp observation they discovered a different phenomenon, namely, the Superfluidity of helium-3.
- The breakthrough in low-temperature physics won them the 1996 Nobel Prize for Physics.

Problem of Polymer Solution

A Polymer solution that turns out to be a cloudy sticky problem.

Stephanie Kwolek, a women chemist at DuPont first made the observation that led to the invention of Kevlar.

Convinced that the unusual solution could be spun into fibers, Kwolek spent several days urging her colleagues to spin it and test its physical properties.

They were all amazed when the test results revealed how strong, stiff, and yet lightweight the fiber was.

Watching Dragonflies

- Delicate bodies
- Dart at high speeds
- Secret of water sac
- Discovery of the pilot flying suits

Moon Rocks....

Putting Man on the Moon

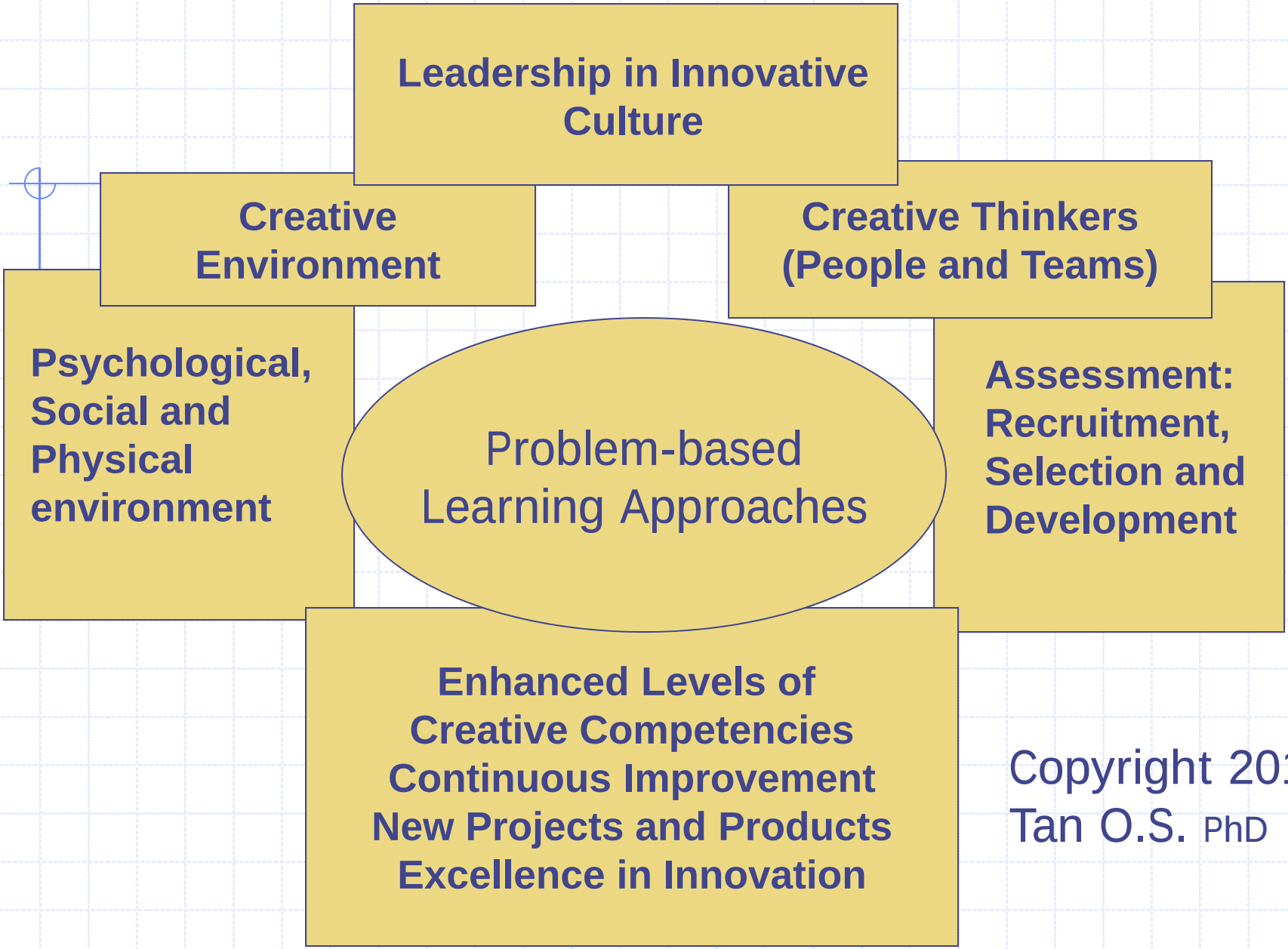
- Material Science
- Digital Power
- Life Science
- Waves Technology
- Satellite and Telecommunication

Problem triggers

- Context for engagement
- Goal setting and goal-directed behaviors
- Need for knowledge, competence
- Active search for meaning, information and solution

Observations at Multi-nationals

Philips Electronics, Kodak, Datacaft Asia, IAI, Swiss Microelectronics, SIA



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Philips Electronics (DAP)

- Simple science
- Playing with problems
- Breakthroughs with multiplier effects

Philips Electronics: Observations of the most innovative design engineers

- A special motivation, holistic involvement
- Abilities to harness resources and intelligences
- How to generate ideas, to be divergent in their thinking
- Be analytical and systematic
- Analogical thinking
- Saw the big picture
- Able to bring ideas into fruition
- What to connect to and when and how to connect
- Knew how to collaborate

Making use of the power of problems has been a useful corollary of the PBL movement.

Breakthroughs in science and technology are often the result of fascination with problems. Great learning often begins with preoccupation with a problem, followed by taking ownership of the problem and harnessing of multiple dimensions of thinking.

Problems and the questions associated with them when strategically posed can enhance the real quality of thinking. What is often lacking in education today is the effective use of inquiry and problem-based learning approaches

A wise man learns from
experience and
an even wiser man
from the experience of others.

- *Plato*

Key Developments

Play
Curiosity
Discovery
Problem-solving

7

Discovery & Identity Foramtion
- Kinesthetic potentials
- Academic potentials
- Life skills
- Independence

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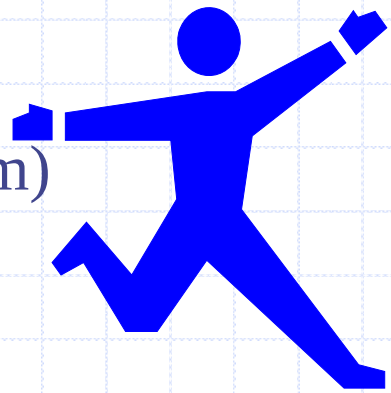
Establishing Foundations
- Language (Verbal)
- Mathematics (Quantitative)
- Emotional Intelligence (Self-Esteem)
- Diligence
- Conscience



Life Vision & Aspirations
- Values
- Career goals
- Interdependence

Using Problem Solving to Nurture the Child's Learning Potential

- Give CONFIDENCE
- Create CURIOSITY
- Plan MOTIVATION
- Draw EFFORT
- Give RESPONSIBILITY
- Encourage INITIATIVE
- Reward PERSEVERANCE
- Show CARE

In solving real-world problems, we need to realize that a whole range of cognitive processes and mental activities are involved.

The mind has to go through cycles and iterations of systematic, systemic, generative, analytical and divergent thinking.

Cognitive Functions

- Connecting
- Imaging
- Abstracting
- Empathizing
- Transforming information
- Playing with ideas
- Imagination

Cognitive Functions

- Configuring (systems and holistic thinking)
- Relearning
- Rethinking
- Observing and making use of observations
- Recognizing and making patterns
- Generating fresh arguments and explanations
- Analogizing

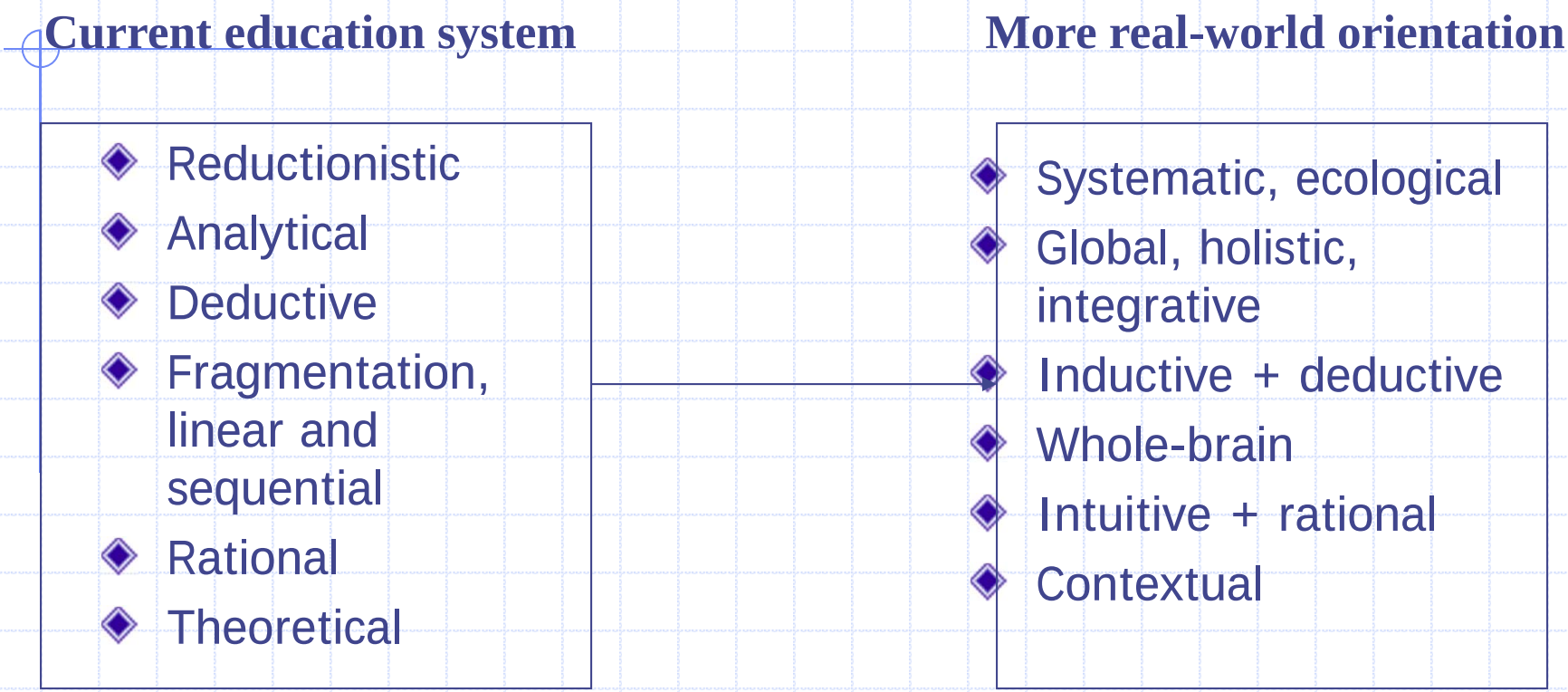


Figure 2.3 A paradigm shift for educational systems

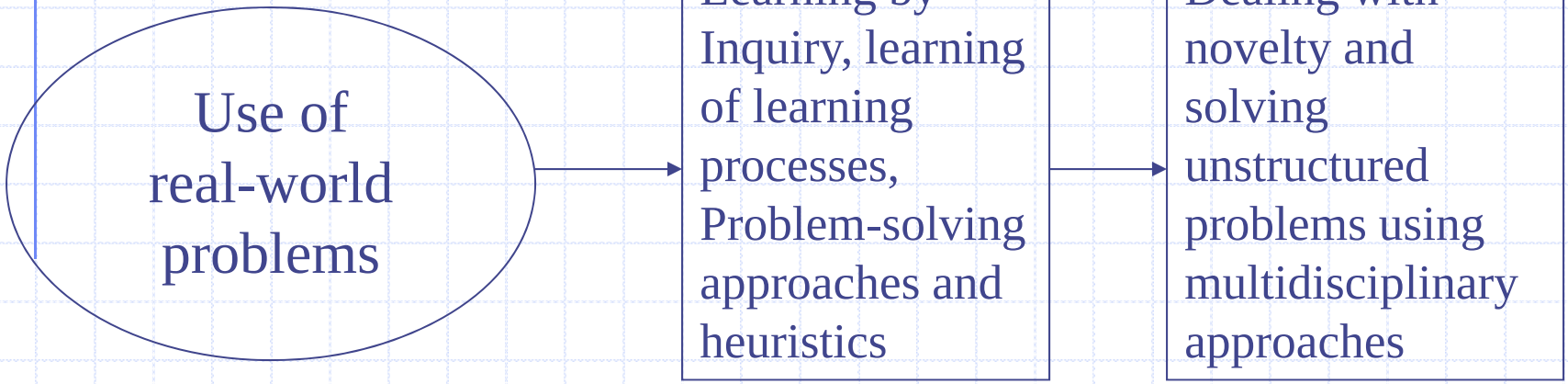
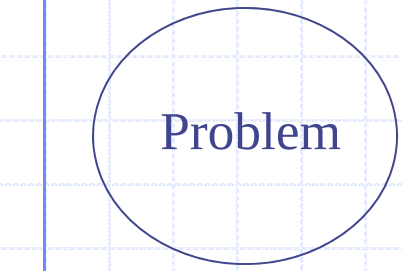


Figure 2.4 Schema of PBL approaches



Examples of psychological happenings:

- Context for engagement
- Curiosity
- Inquiry
- Quest to address a real world issue

Examples of learning and cognition:

- Confronting unstructuredness, ill-structuredness and novelty
- Active search for information
- Proactive immersion in task
- Conscious and subconscious investment of time on task
- Motivation to solve the problem: need for meaning and explanation
- Goal orientation
- Need for generative thinking, analytical thinking, divergent thinking and synthesis

Figure 2.5 PBL and cognition

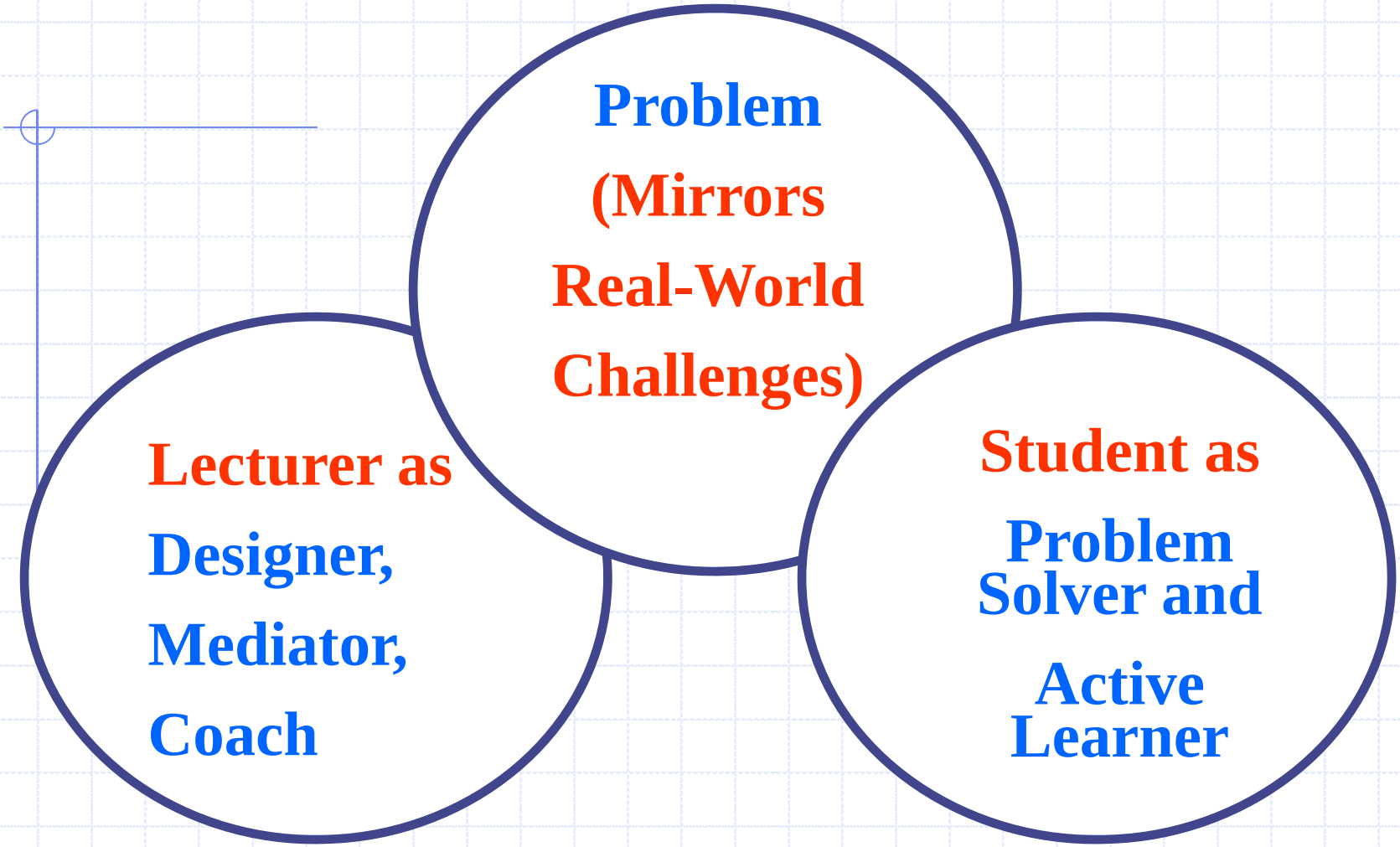
PBL optimizes on goals, needs and the motivation that drives learning.

It simulates the kind of problem-solving cognition needed in real-world challenges.

The PBL innovation
incorporates the use of e-learning accessibility, creative interdisciplinary pursuits and the development of people skills.

#3
What is Problem-based Learning?

Problem-Based Learning



Real-world problems form the anchor for the learning and thinking processes of students.

Essence of PBL

- Builds curricula around real-world problems.
- The problem is the starting point of learning.
- Learning to learn and self-directed (independent) learning are essential.
- Learning is collaborative, communicative and cooperative.
- Development of inquiry and problem-solving skills is as important as content acquisition.

Chapter 3
What is Problem-based Learning?

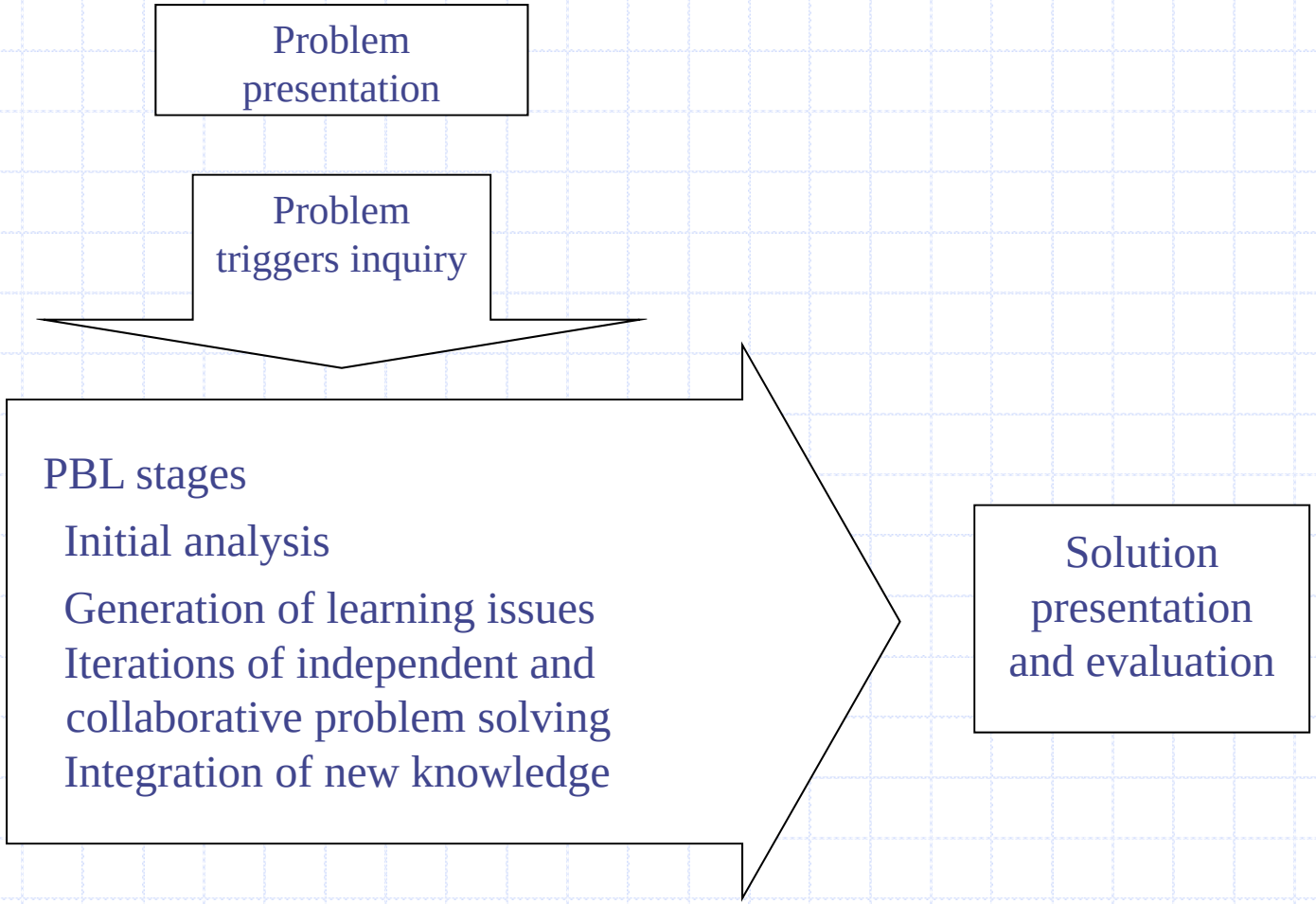
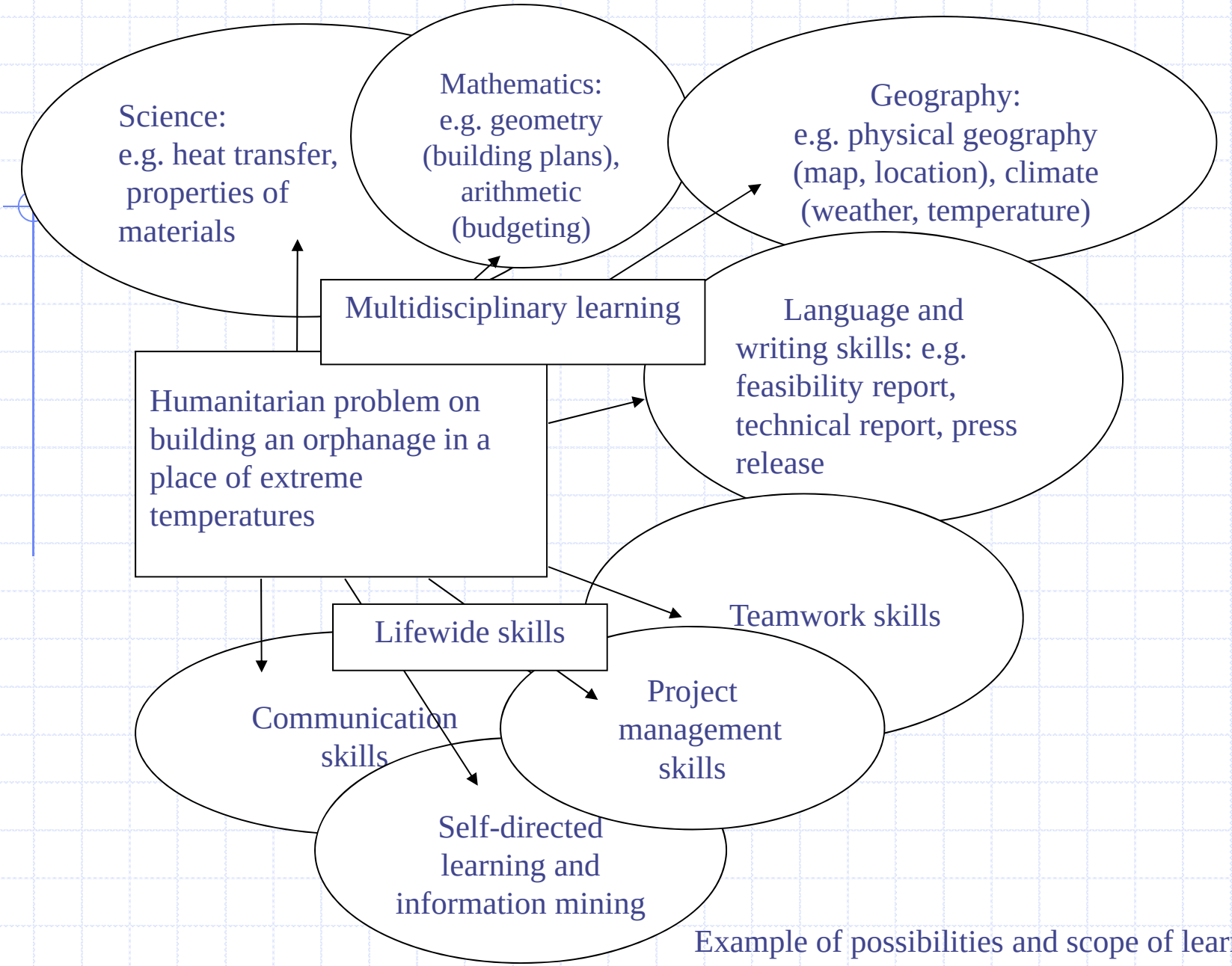


Figure 3.1 Components of the PBL approach

Design of Problem

Building an orphanage in Mongolia



Example of possibilities and scope of learning

Young children and teenagers in Wonyue, a village town in North Korea are dying of hunger. A humanitarian team is there providing food at a shelter. The centre is providing rice and some vegetables...

You and two of your friends would like to start a business to design Web pages for corporate clients. Amongst you there is a great deal of expertise in Web-based programming. Each of you agreed to put in $2,000 to start this business. How would you go about registering and setting up your business?

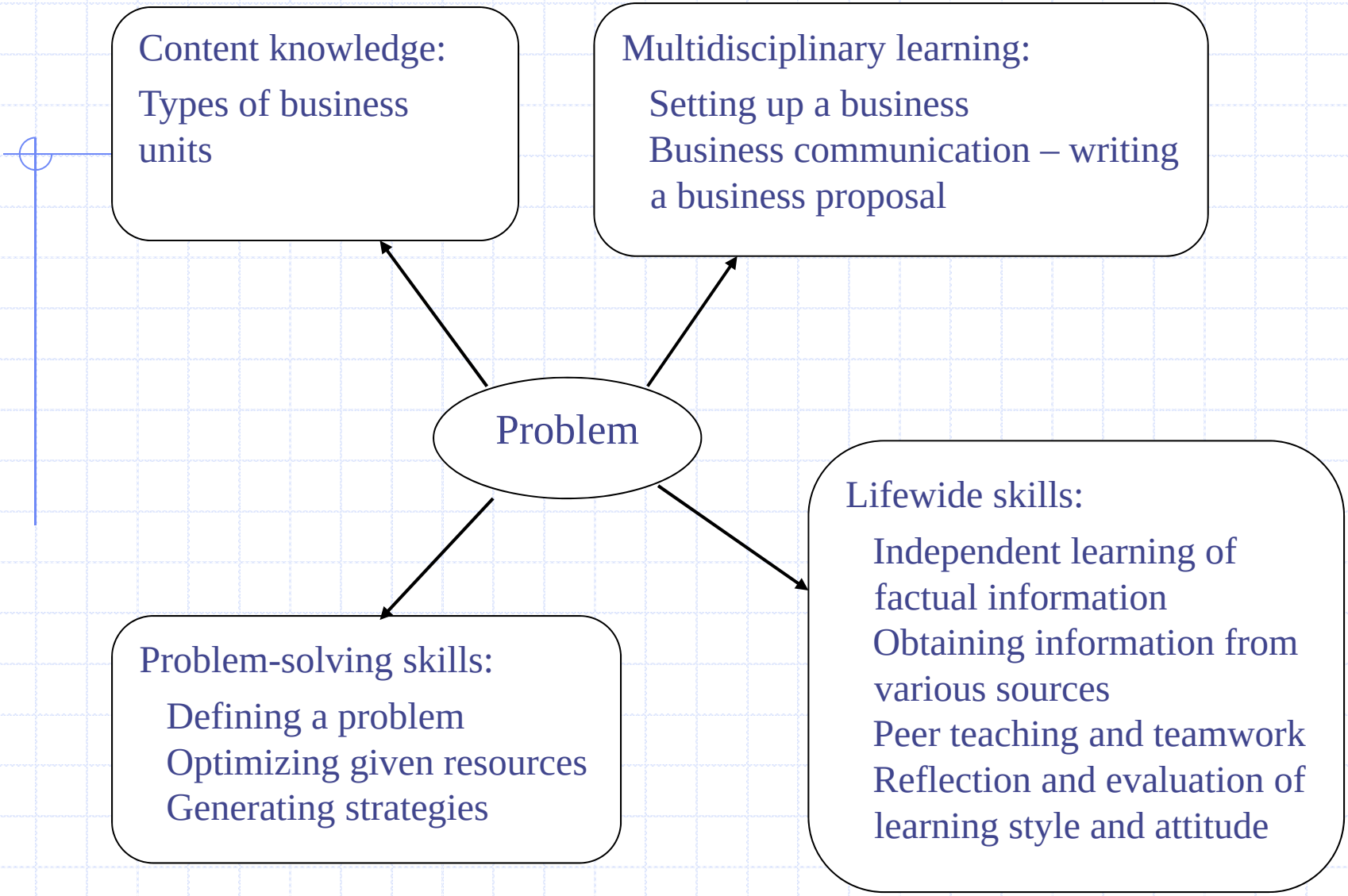


Figure 6.3 Example of the goals of a business problem

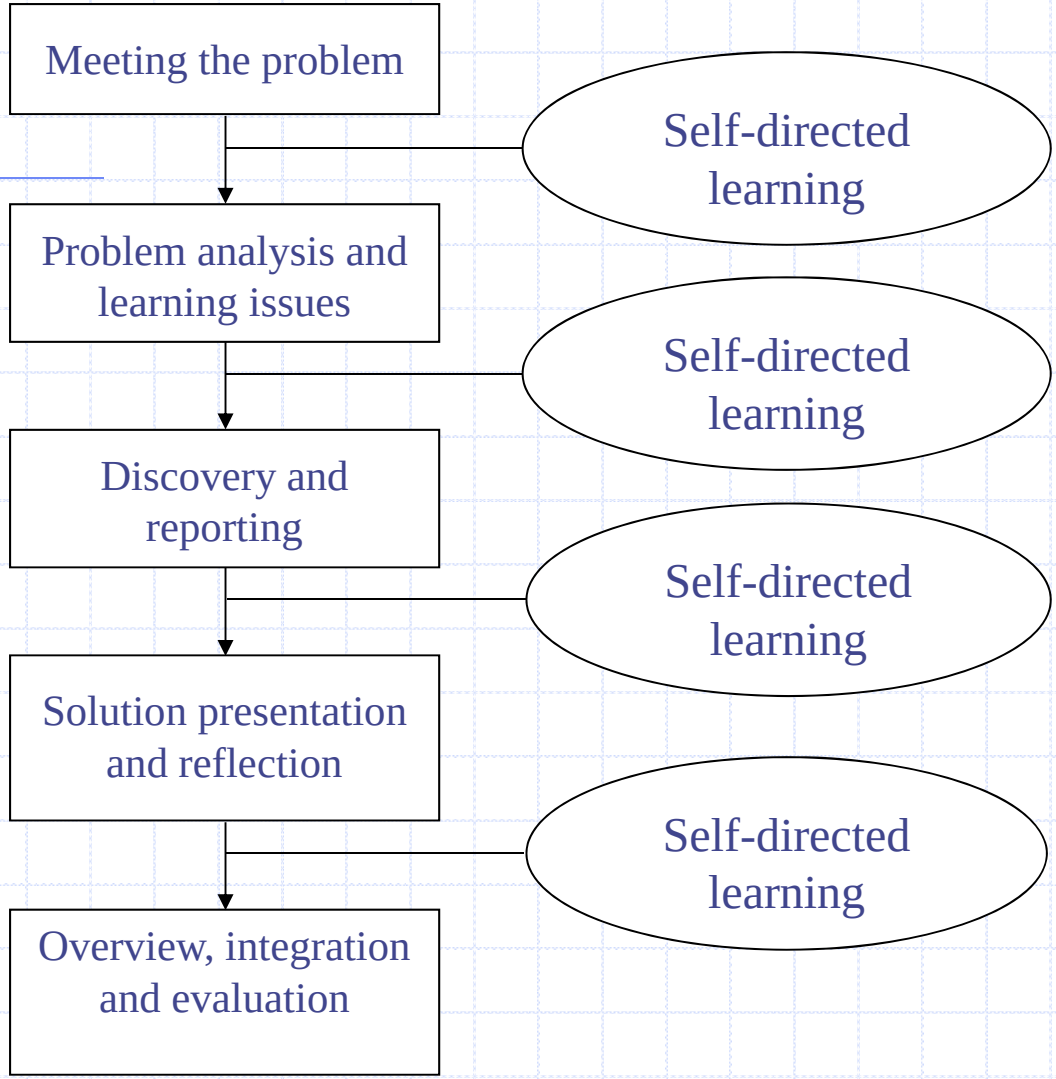


Figure 3.2 The PBL process

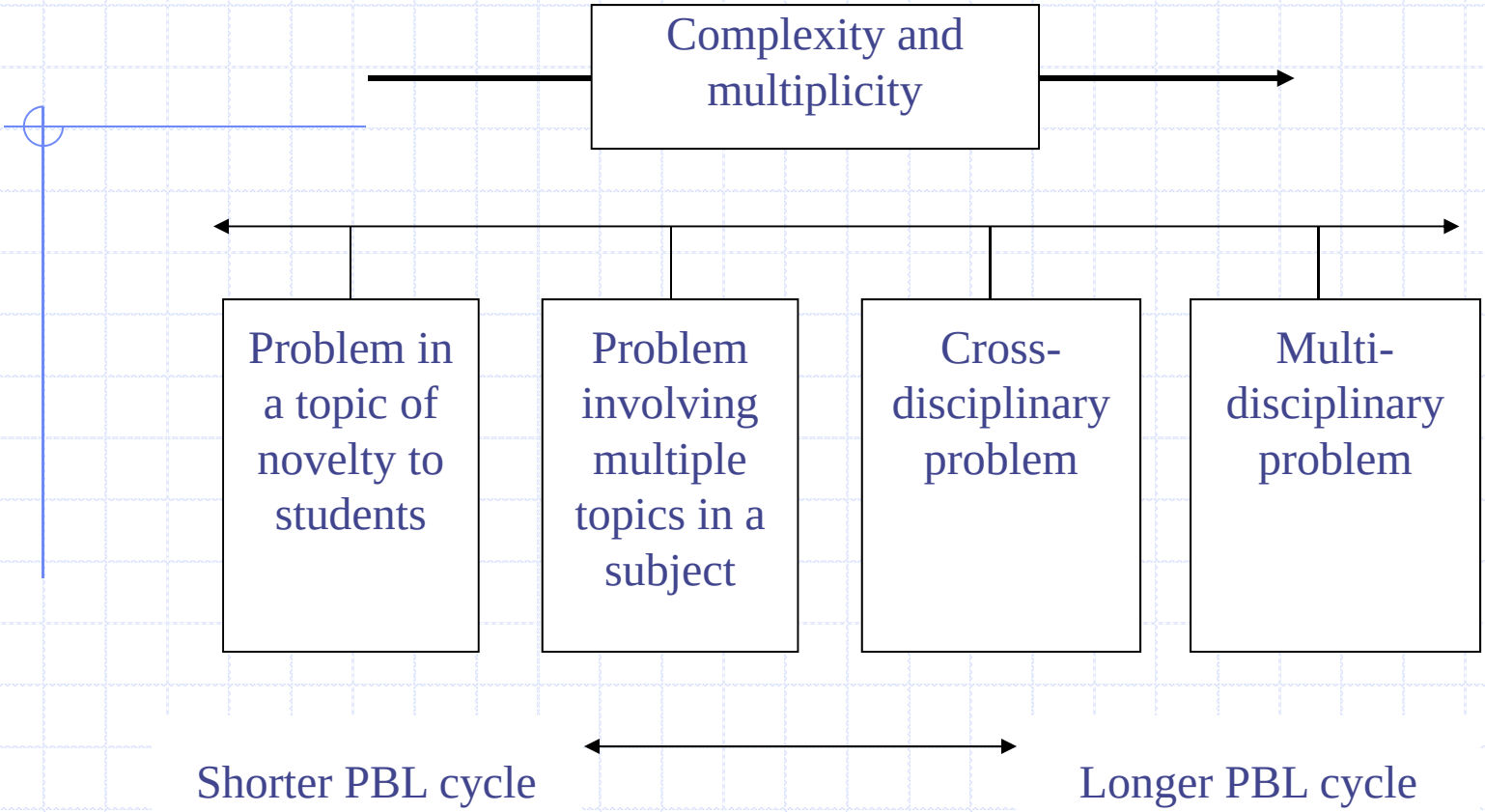


Figure 3.5 Problem complexity and multiplicity

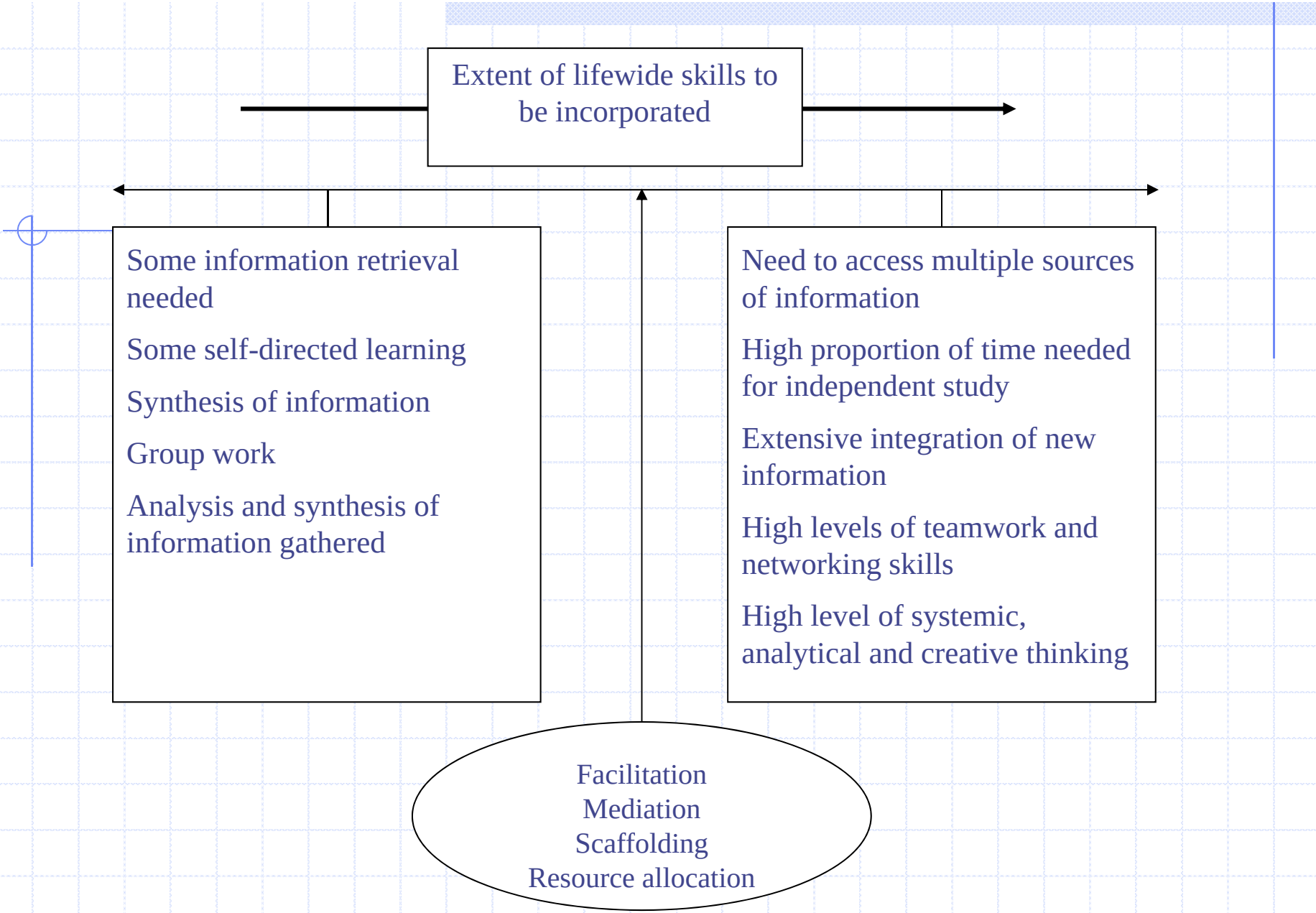


Figure 3.6 PBL goals in terms of the extent of lifewide skills to be learnt

The 3 C's of PBL Process

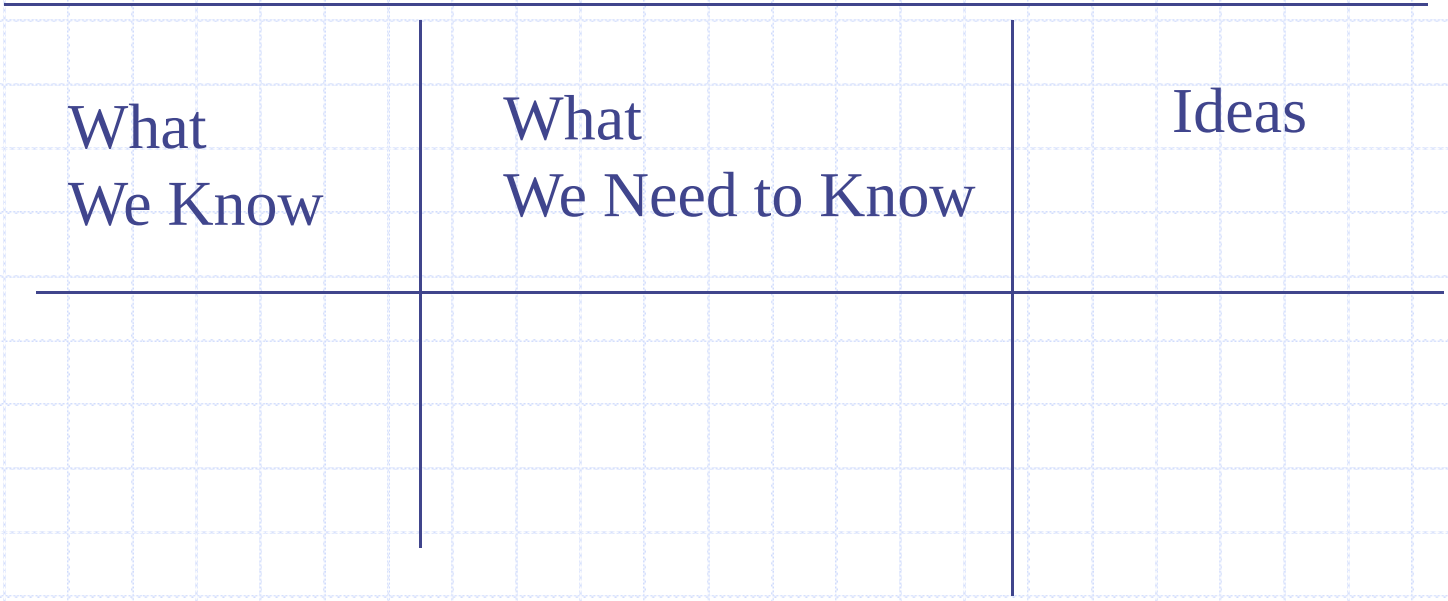
- Untapped Riches of Cognitive Process and Learning
- Power in the IP Model: Collecting-Connecting-Communicating (Note developments in CI and neuroscience)

PBL Facilitation: 3 Cs

- Collecting
- Connecting
- Communicating

IDEAS	FACTS	LEARNING ISSUES

Problem-Analysis Inquiry Process: Examples of Scaffoldings



A. Problem-based tutorial

Some crucial questions	Some useful prompts
1. Is there a situation in need of improvement?	▪ analyse the data ▪ identify cues*
2. What is/are the situation(s) in need of improvement?	▪ write down this/these situations
3. What are your possible explanations for these situations?	▪ list tentative hypotheses ▪ which are the most likely hypotheses?
4. What do you need to know in order to confirm or reject these explanations?	▪ list learning needs
5. Where might you find what you need to know?	▪ identify possible resources ▪ library videos, persons, experience, etc
6. How will you best organise yourselves to discover what you need to know?	▪ determine resources to be pursued ▪ plan your group's activities for self-directed study ▪ decide how you will share this information with your group

B. Self-directed study (3 - 6 hours)

C. Situation review tutorial	
Some crucial questions	**Some useful prompts**
1. How does the knowledge you have gained help you to confirm, hold or reject your hypotheses?	■ share information ■ review hypotheses in the light of information
2. Do you have need for further information?	■ list the questions that the group have answered in fixed resource sessions
D. Situation summary tutorial	
1. Will the knowledge you have gained enable you to accept, reject or hold hypotheses in order to make clinical judgements?	■ review SINI ■ review hypotheses
2. What clinical judgements can you make in light of confirmed, rejected or held hypotheses?	■ with further information, review SINIs ■ review hypotheses
3. What is the best way of acting on your clinical judgements?	Develop an action plan : ■ identify goals ■ identify ways to achieve goals ■ identify ways of reviewing your plan
E. Review of learning packages	
1. What do you think you have learned by working through this package?	■ how might this help you in your work as a nurse? ■ what are your reflections on the group process during this LP?

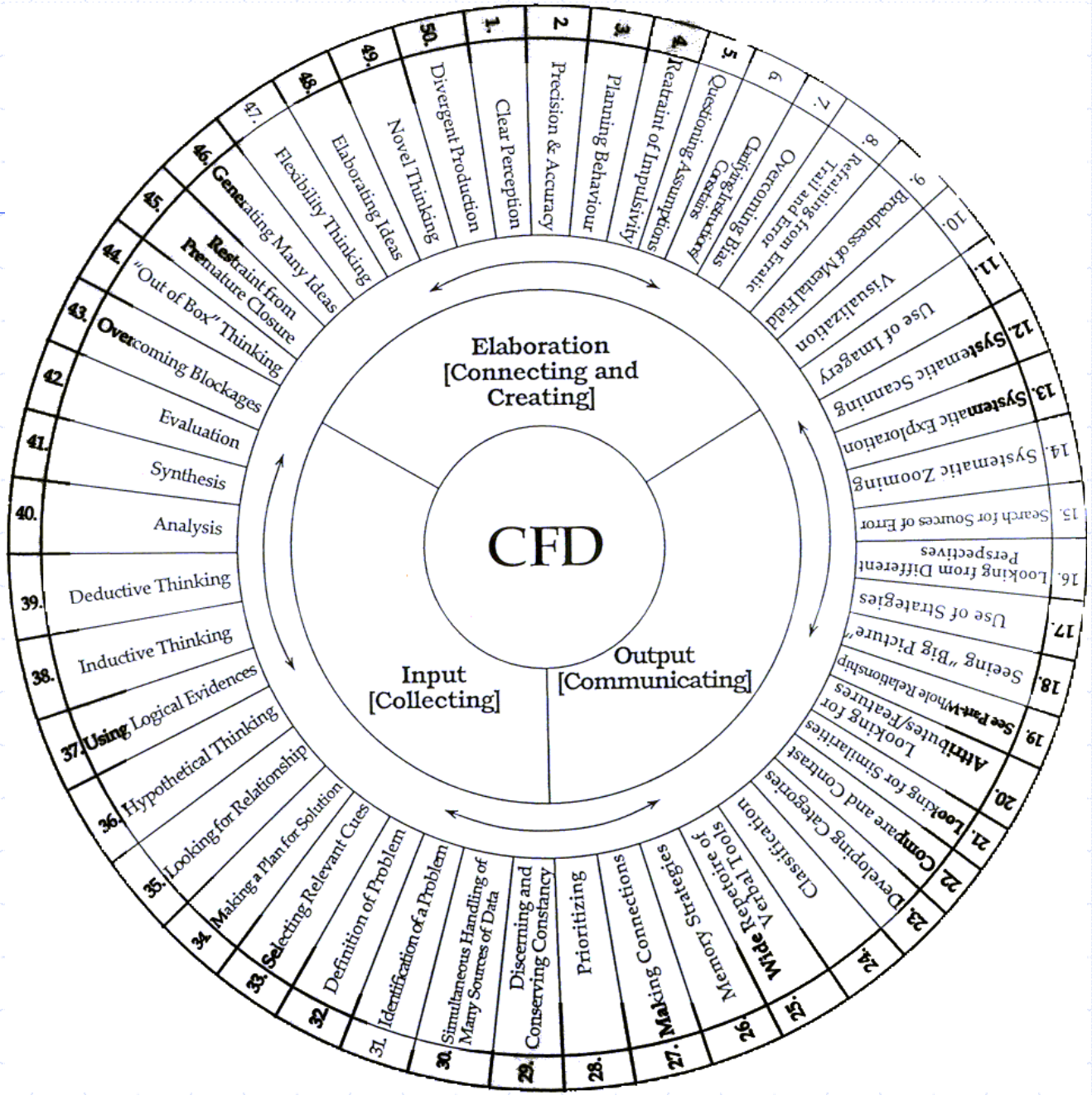
What is the Situation In Need of Improvement (SINI)	Hypotheses	Our Learning Needs

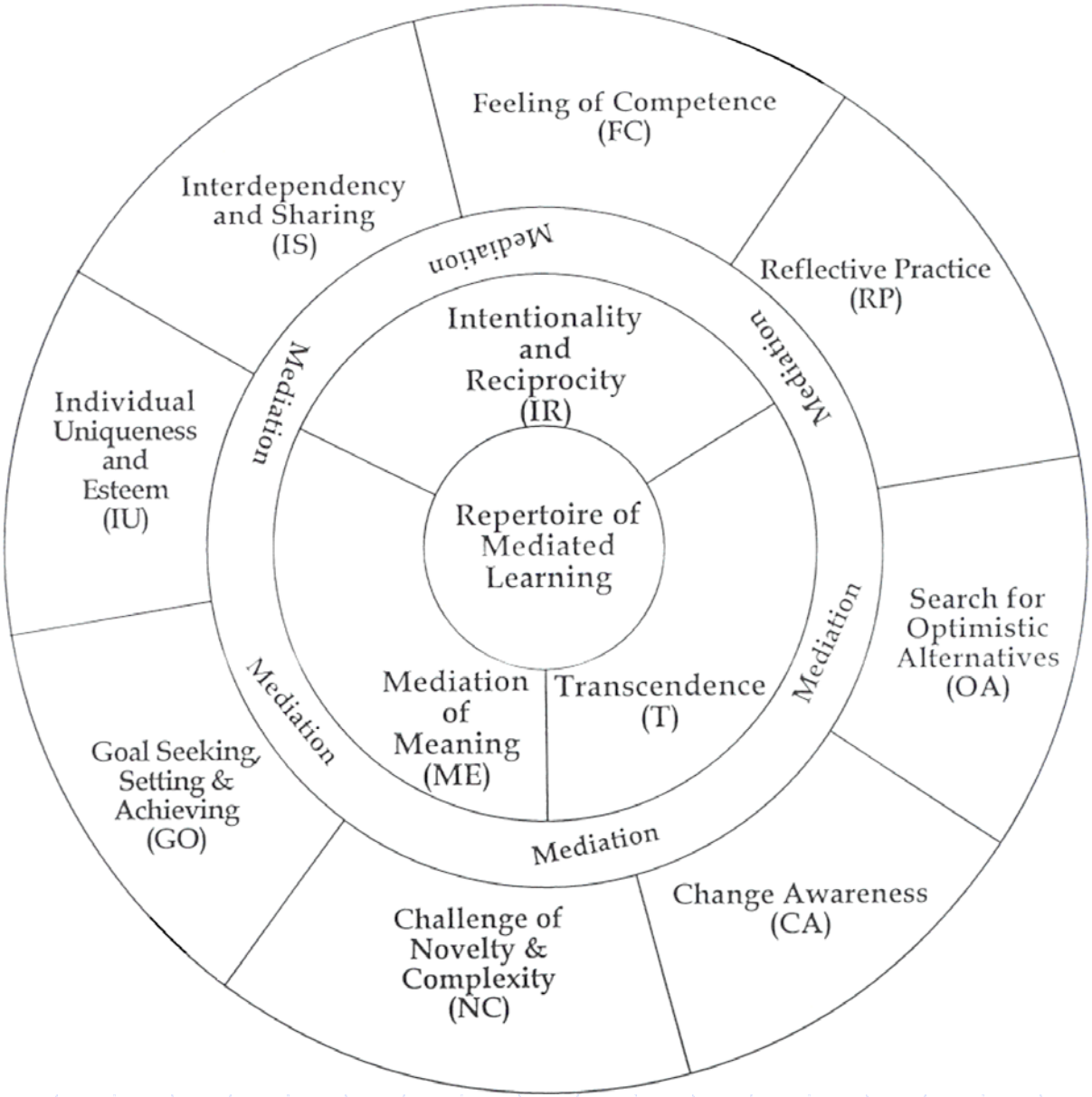
Chapter 4
Facilitating Problem-based Learning Processes

We need to use learning processes that will move students towards independent, lifewide and lifelong learning. The learning environments we establish should encourage reflective thinking, critical evaluation and inventive thinking.

People have different perspectives and views about a problem. We should learn to exchange views to gain a better understanding of a problem situation rather than assume a “correct” or “best” answer in one’s own mind. Furthermore, when it comes to understanding the different perspectives of a problem, it can be said that none of us is as smart as all of us.

#4
PBL Facilitation and Inquiry-based Learning


CFD
Elaboration [Connecting and Creating]
Input [Collecting]
Output [Communicating]
1. Clear Perception
2. Precision & Accuracy
3. Planning Behaviour
4. Restraint of Impulsivity
5. Questioning Assumptions
6. Clarifying Inadequacy
7. Overcoming Bias
8. Refraining from Erratic Trail and Error
9. Broadness of Mental Field
10.
11. Visualization
12. Use of Imagery
13. Systematic Scanning
14. Systematic Exploration
14. Systematic Zooming
15. Search for Sources of Error
16. Looking from Different Perspectives
17. Use of Strategies
18. Seeing „Big Picture"
19. See Part-Whole Relationship
20. Attributes/Features
21. Looking for Similarities
22. Comparate and Contrast
23. Developing Categories
24. Classification
25. Verbal Tools
26. Wide Repertoire of
27. Memory Strategies
28. Making Connections
29. Prioritizing
30. Discerning and Conserving Constancy
31. Simultaneous Handling of Many Sources of Data
32. Identification of a Problem
33. Definition of Problem
34. Selecting Relevant Cues
35. Making a Plan for Solution
36. Looking for Relationship
37. Hypothetical Thinking
38. Using Logical Evidences
39. Inductive Thinking
40. Deductive Thinking
41. Analysis
42. Synthesis
43. Evaluation
44. Overcoming Blockages
45. "Out of Box" Thinking
46. Premature Closure
47. Restraint from
48. Generating Many Ideas
49. Flexibility Thinking
50. Elaborating Ideas
1. Novel Thinking
2. Divergent Production


Feeling of Competence (FC)
Reflective Practice (RP)
Search for Optimistic Alternatives (OA)
Change Awareness (CA)
Challenge of Novelty & Complexity (NC)
Goal Seeking Setting & Achieving (GO)
Individual Uniqueness and Esteem (IU)
Interdependency and Sharing (IS)
Mediation
Mediation
Mediation
Mediation
Mediation
Mediation
Intentionality and Reciprocity (IR)
Repertoire of Mediated Learning
Mediation of Meaning (ME)
Transcendence (T)

Learning + Thinking

$$= \mathbf{f\ (connections)}$$

$$= f\ (C_1, C_2, C_3, C_4, \ldots)$$

C_1 Connecting with Prior Knowledge and Experience

C_2 Connecting with Real World Context

C_3 Connecting with Theories

C_4 Connecting with Peoples' Perceptions (Peers, Others, etc)

Problem Analysis

- Cognition: Connecting with prior knowledge (C-C-C activated), further clarification, scan-span-searching, “organsational” thinking, systematic exploration, open-mindedness,creativity and divergence

Students' Formulation of Learning Objectives

- Commitment to the cause of the problem and development of motivation to learn, manage and solve
- Learning issues are aligned and connected to learning process and related to practical solving of the problem
- Learning issues can be multi-disciplinary
- Know what is important to know, asking key questions

PBL helps make students' thinking more "visible" through collaborative learning.

Student Reporting to the Group

- Re-phrase knowledge acquired,demonstrate mastery of knowledge
- Integrate knowledge from different disciplines
- Correct misconceptions
- Explanations and application of knowledge from various sources to solve the problem

Review and Evaluation

- Critique of learning resources (Value, reliability, etc)
- How do you apply new knowledge to the problem? Have you learned everything you need to know?
- Reflection and critique of prior thinking and knowledge
- New hypothesis in the light of new learning?

Review and Evaluation

- Closure: Lecturer's summary and integration of what has been learned (major principles, concepts, gaps, etc)
- Evaluation of PBL processes
  - problem-solving
  - self-directed learning
  - group support and teamwork
  - Self-evaluation

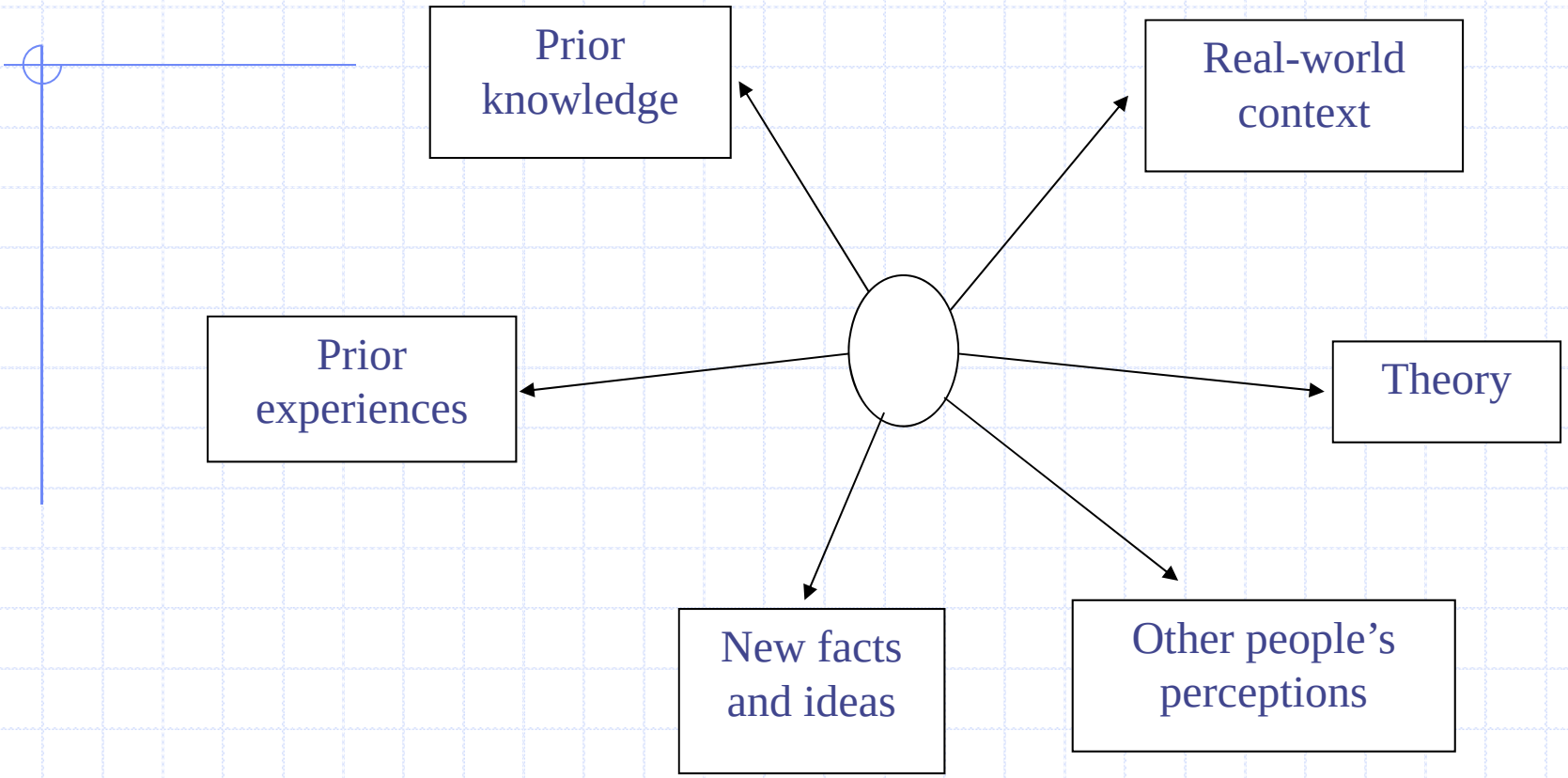
Table 4.1 Facilitating PBL groups

- If the problem is not given beforehand, give time for more thorough individual reading. Get students to think, reflect and make notes.
- Move around to monitor the quality of discussion. Prompt, question and ensure intended scope and preoccupation.
- To kick off the discussion, encourage every student to articulate his or her perception of the problem so that everyone arrives at a clearer mental representation of the problem scenario.
- Initial brainstorming may involve putting down words, phrases and ideas that come to mind with respect to the scenario.
- Remember that PBL involves a problem and the commitment of problem solvers; hence, developing ownership of and commitment to the problem is an important aspect of the first tutorial.
- Ask students to develop a problem statement for each problem scenario. The statement is an articulation of how the group paraphrases and takes ownership of the problem. It is also a form of contracting between the group and the tutor.

- Refrain from giving answers, disseminating or teaching anything (except PBL processes) in the first session!
- Ask another question for every question raised. Your job is to make the students' thinking visible – not your thinking or knowledge at this point!
- Ask each member what he or she thinks. Ask what the group thinks.
- Begin the inquiry with simple processes like describing the scenario in the students' own words and linking it to their own experience and prior knowledge. Note that the initial experience can be frustrating.
- Get some (the better ones), if not all the groups, to share their problem statements.
- Emphasize that this is the beginning of their self-directed learning journey and that they are to deliberate and inquire further. Suggest a fixed amount of self-directed learning time (e.g. two hours) when it comes to allocation of self-directed deliberation and information search pertaining to the problems.

Table 4.3 Facilitating understanding of the problem

- This stage involves helping students with the following:
- Reading thoroughly, observing and reflecting (often underlining key facts, making notes and enquiries)
- Learning to clarify and ask questions (e.g. about terms, concepts, assumptions, vagueness and lack of data)
- Overcoming sweeping perceptions and assumptions
- Avoiding unwarranted narrow perceptions and bias
- Developing systematic and thorough information gathering, accuracy, precision, as well as breadth and depth of perception
- Contextualizing and understanding the nature of the problem confronted
- Reframing the problem (it is only when you can state the problem in your own words that you can solve it!)
- Understanding limitations (knowing things beyond our control)
- Understanding delimitations (the need to deliberately define the scope of problem solving or work within the available expertise or resources)
- Using questions to identify (and state) the problem
- Asking why and why-not questions



Enhanced connectivity in thinking with multiple and helicopter perceptions and harnessing of resources

Figure 5.1 Connectivity in thinking

Table 5.1 Facilitation of PBL problem resolution process

Problem analysis

- Cognition: connecting with prior knowledge (3Cs activated), further clarification, scan–span–searching, “organizational” thinking, systematic exploration, open-mindedness, creativity and divergence
- Tutor’s prompting to ensure key areas to be learnt are not overlooked

Problem summary and synthesis

- Overview of what has been analysed and hypothesized
- Articulation and summarizing of key information
- Clarity of mental field and mental representation of problem
- Systematic and systems (holistic) thinking

Students' formulation of learning objectives

- Commitment to the cause of the problem
- Ownership of roles and responsibilities
- Zeroing in on what is important to know and learn
- Gaps in knowledge formulated as learning issues (in the form of questions)
- Learning issues aligned and connected to context
- Learning issues can be multidisciplinary

Self-directed learning and self-study

- Activation of prior knowledge and goal-directed reading
- Immersion in the relevant resources (e.g. Internet, reference material)
- Learning with a view to share
- Evaluating sources of information

Reporting to the group

- Learning by teaching others
- Articulation and paraphrase of knowledge acquired
- Demonstration of mastery of knowledge

Iteration of group problem solving

- Integration of knowledge from different disciplines
- Correction of misconceptions
- Explanation as well as application of knowledge from various sources to solve the problem
- Critique of value, validity and reliability of information and resources brought to the group
- Application of new knowledge to the problem
- Reflection and critique of prior thinking and knowledge
- Doing all the necessary learning and developing new hypotheses in the light of new learning

Review and evaluation

- Closure: tutor's summarization and integration of what has been learnt (major principles, concepts, gaps, etc.)
- Evaluation of PBL processes (e.g. problem solving, self-directed learning, group support and teamwork)

Facilitating inquiry for deeper learning is a major challenge. Effective

PBL tutoring employs a good range of scaffolding and questioning

techniques. Effective scientists, entrepreneurs and decision makers know

how to ask good questions to help arrive at solutions. The goal of inquiry

in PBL is to help students internalize such dialogues.

Mediation of Thinking and Metacognition (Cognitive Coaching)

- Meeting the problem
- Problem summary
- Problem analysis
- Formulation of LO (Self-directed learning)
- Bringing new knowledge
- Problem solution
- Review
- Evaluation

Meeting the problem	What are your thoughts on this scenario? What comes to your mind? What do we know? What are the statements of facts we can identify? What is meant by the sentence...? What do you think about that statement? Do you have any idea about this term (concept, etc.)? Could you explain what is meant by the term (concept, etc.)?
Problem summary	How would you paraphrase...? Describe in your own words... Describe the sequence: what came/happened first…followed by what? What can we say about the who, when and where? Could you restate what the group discussed? Does the group have the same mental picture of…?

Problem analysis	What can we make out from the information? What additional information might we need? What do we need to know? Can we know for certain...? Could you think of anything else? What does that link you to? Have you considered all the possibilities? Do we have enough data/knowledge to suggest that...?
Formulation of learning objectives	What is important for you to solve the problem? Have you listed all the key questions? Why do you think this issue is important? What makes you include...? What kinds of resources might be helpful?

Bringing new knowledge and problem solution	Describe what you have learnt about... Explain what you understand by... Specifically, what do you mean by...? How do you know? Could you elaborate on...? How valid and reliable is this? How would you connect what you learnt to...? How does it work? Why is it so? Explain the strategy... Explain your solution... What is at stake if we do this...? What is at stake if we do not...? What are the pros and cons? What are the consequences? What would the end product look like?

Review and evaluation

- What are three key things you have learnt about the problem?
- What did you learn about yourself and your peers?
- What did you learn about your problem-solving approaches?
- What did you learn about your independent learning?
- How different would it be if...?
- What other sources and counterchecks do you have?
- What solution might you propose to meet the following criteria?
- How do you apply it to another situation?
- What other follow-up might you recommend?
- If you'd do it again, what might you do more/less?
- How might you do it differently the next time?

PBL is about making students' thinking visible and stretching multiple ways of thinking to confront problems that are ill-structured and novel. PBL coaching involves active mediation of purpose, meaning, transfer of learning, optimistic seeking of alternatives, goal-directedness, challenge, collaboration and self-reflection.

#6
Design of Problems

One of the most powerful resource for those facilitating project work...

The roots of problem design are real-world problems.

Professors need to have up-to-date knowledge of the problems that professionals in their disciplines are working on today.

Teachers need to be in touch with real-world challenges in the society. The ability of educators to use problems creatively is a major aspect of educational innovation.

What constitutes a problem? (Ideas for project work!)

- Failure to perform
- Situations in need of immediate attention or improvement
- Finding better and new ways to do things
- Unexplained phenomena or observations

What constitutes a problem?

- Gaps in information and knowledge
- Decision making problems
- Need for new design
- Need for new invention

To move into an inventive culture, education and training should look at all kinds of problems and learn from problem solving, whether they be situations in need of improvement, better ways of doing things, closing information gaps, understanding a new phenomenon, or new designs or inventions.

Such learning should span disciplines, businesses and industries

Table 6.1 Features of problem design

PROBLEM FEATURE	ISSUES TO ADDRESS
Characteristics	◆ What is the real-world relevance of the problem? ◆ What is the curriculum relevance? ◆ What is the level of difficulty? ◆ What is the level of complexity? ◆ Is it an interdisciplinary problem? ◆ Does the problem call for integration of multiple disciplines (or topics)? ◆ How open is the problem (in terms of possible solutions)? ◆ Does it call for a final product?
Context	◆ Is the problem unstructured (ill-structured)? ◆ Does it trigger curiosity? ◆ Will it motivate ownership? ◆ Does it appear challenging? ◆ Are there sufficient elements of novelty?

PROBLEM FEATURE	ISSUES TO ADDRESS
Learning environment and resources	◆ How can the problem stimulate collaborative inquiry? ◆ What kinds of independent learning can be incorporated? ◆ What is the extent of guidance needed for using the learning resources? ◆ What kinds of information resources are expected (e.g. library resources, the Internet)? ◆ Does the problem require further data collection? ◆ Will field work be incorporated? ◆ Will information gathering include interviews and experts' views? ◆ What else might we need to solve the problem?

PROBLEM FEATURE	ISSUES TO ADDRESS
Presentation	◆ Do we use a problem scenario? ◆ Should it be a short scene or multiple scenes? ◆ Does the problem scenario come with hypertext? ◆ Do we need a detailed case write-up? ◆ Can we use video clips? ◆ Can we use audio news? ◆ Can we do a role play? ◆ Can we simulate a client requirement? ◆ Are there relevant newspaper cuttings? ◆ What about magazine or journal reports? ◆ Are there Web sites that can be used?

Good problem design takes into consideration:

- the goals of PBL
- students' profiles
- problem characteristics: authenticity, curriculum relevance, multiplicity and integration of disciplines
- the problem context: ill-structuredness, motivation of ownership, challenge and novelty
- the learning environment and resources
- problem presentation

#7
Curriculum Development in PBL

Chapter 7
Curriculum Development in Problem-based Learning

Curriculum considerations

Mega level (the *why*)

- Graduate profile desired
- Aims of programme: knowledge, skills, attitudes and competencies
- Courses and modules: disciplinary goals

Curriculum considerations (con't)

Macro level (the *what*)

- Courses and modules: learning goals of subjects, syllabus (content knowledge, list of topics and concepts)
- Assessment goals, structure and criteria
- Course evaluation

Curriculum considerations (con't)

Micro level (the *how*)

- Course structure: timetable for PBL sessions, tutorials, laboratory work and lectures
- Structure of independent learning
- Learning package: problems and learning resources

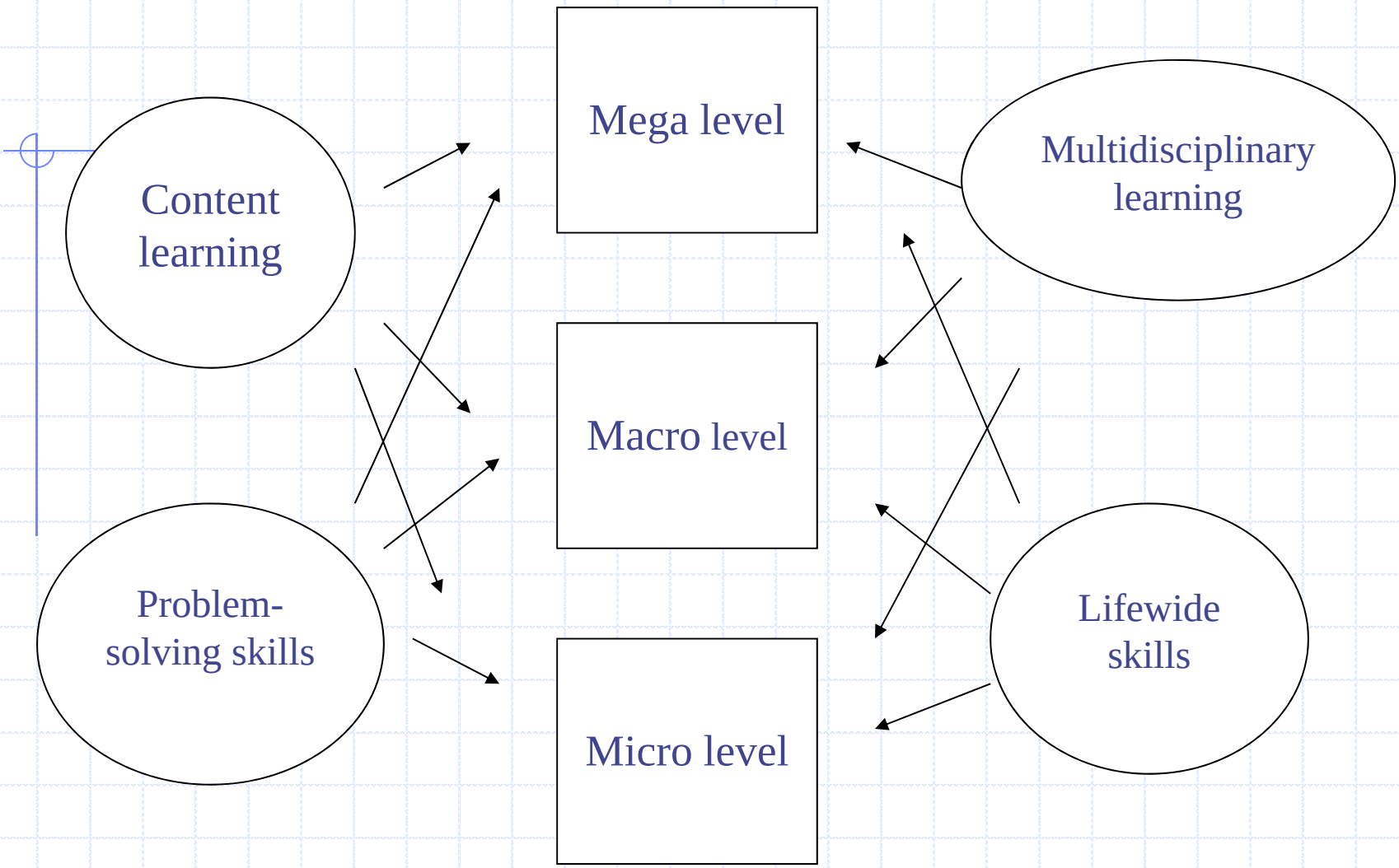


Figure 7.2 Infusing PBL approaches into the curriculum

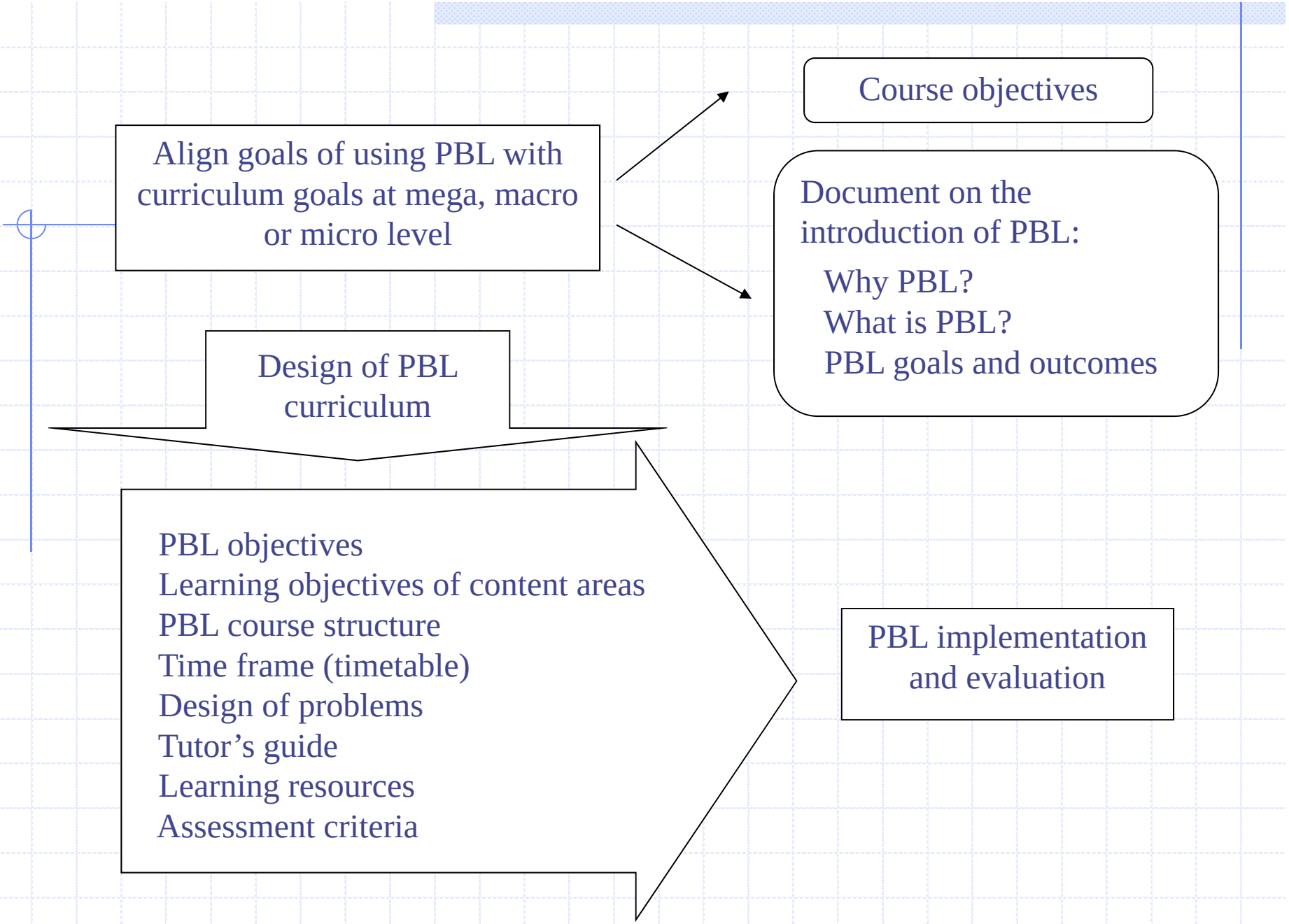


Figure 7.3 Planning a PBL curriculum

PBL CYCLE

- Meet the problem Problem analysis Discovery and reporting Solution presentation Integration and evaluation
- Meet the problem Problem inquiry Generation of learning issues Discovery and peer teaching Solution presentation Review
- Problem encounter Analysis Research and field work Reporting and peer teaching Presentation of findings Reflection and evaluation

PBL curriculum development involves a review of the desired graduate profile, examination of the goals and nature of the disciplines, the employment of PBL cycles, and detailing of resources and assessment criteria. Problems are designed such that learning and assessment are aligned with the curriculum goals and PBL goals.

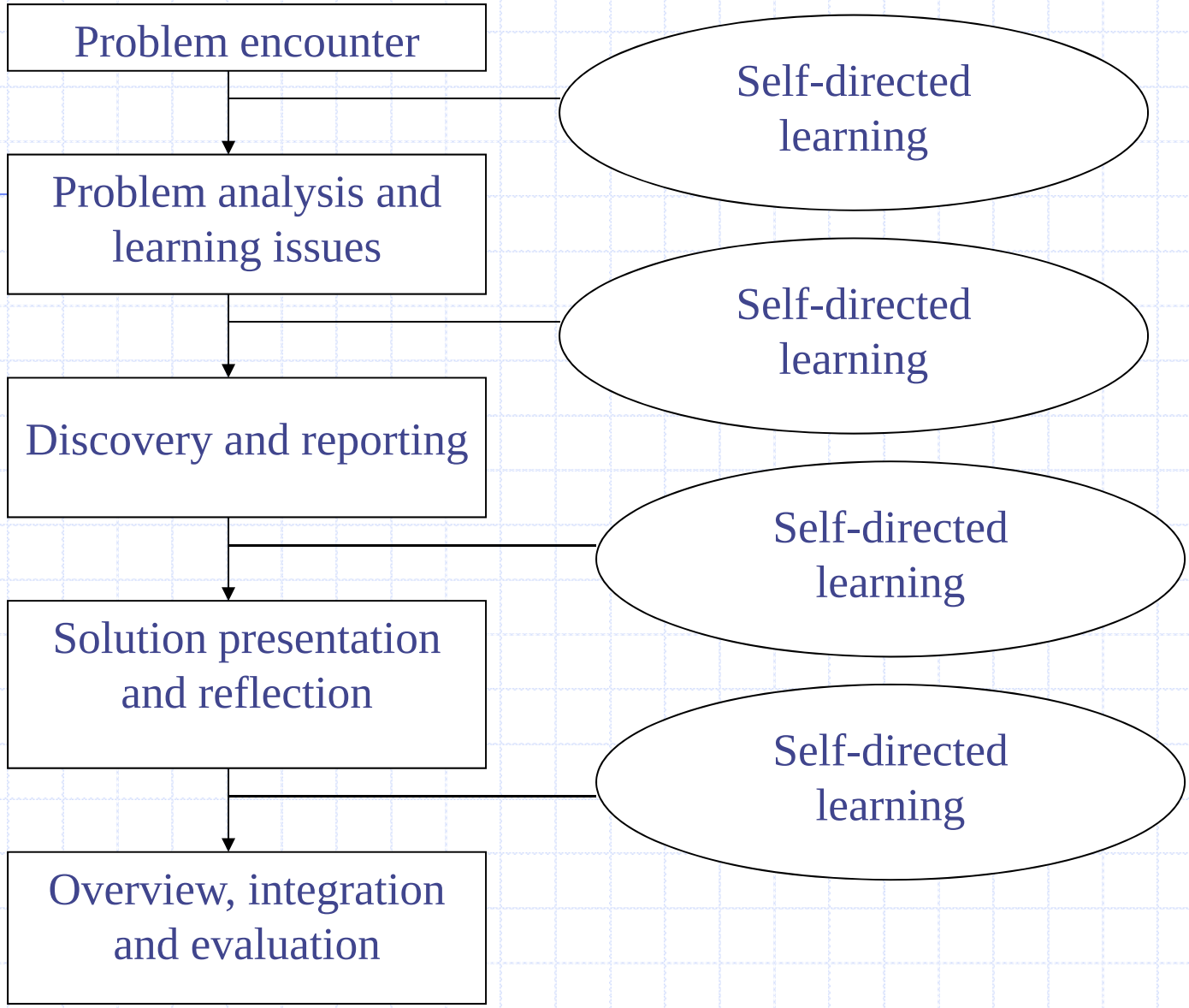


Figure 7.4 PBL cycle for an educational psychology course

Table 7.3 Course outline of the PBL component of an educational psychology course

WEEK	COURSE CONTENT
Induction Week	Introductory lecture PBL preparation Problem encounter
Week 1	◆ Problem statement ◆ Problem scenario and analysis Problem analysis and learning issues
Week 2	◆ Identification of learning issues and formulation of learning objectives ◆ Preparation of self-directed learning and peer teaching

Table 7.3 Course outline of the PBL component of an educational psychology course

WEEK	COURSE CONTENT
Week 3	Discovery and reporting ◆ Report on self-directed learning ◆ Peer teaching
Week 4	Preparation of solution presentation ◆ Group preparation
Week 5	Solution presentation and reflection ◆ Group presentation of findings
Week 6	Overview of learning theories ◆ Q and A ◆ Evaluation

Information and resources

- PBL homepage
- Course objectives
- Course structure
- Portfolio of problem scenarios
- PBL cycle and inquiry tools
- Tutor's guide
- Student's guide
- Resources and links
- Assessment criteria
- Communication system

Table 8.1 Using PBL in e-learning

CURRENT E-LEARNING	PBL E-LEARNING
Changes mode of delivery	Changes paradigm of learning
Passive definition of scope	Active definition of scope
Retrieval of content	Learning of process
Primarily linear structuring of content	Scaffolding of thinking
Little activation of prior knowledge	Activation of prior knowledge
Limited engagement	Inevitable engagement
Flexibility used	Flexibility optimized
Single discipline	Multiple disciplines
Primarily convergent	Encourages divergence
Communication mainly one–one	Communication one–many and many–many
Individual learning	Peer/Collaborative learning
Information search minimal	Information search extensive
Little evaluation of information sources	Emphasizes review and critique of information sources

Some of the underpinning principles of the use of PBL in e-learning are:

- Make use of the power of real-world problems to motivate learning
- Design the learning environment such that it employs the global information network
- Encourage the development of learning-to-learn processes, heuristics, and thinking skills
- Emphasize problem solving and decision making rather than content learning
- Provide for systems of engagement and collaboration
- Provide opportunities for active application of knowledge and self-review
- Optimize the use of flexible structures to support and sustain independence and interdependence
- Develop evaluative and critical use of information sources

Conclusion

Conclusion

- The word *knowledge*, which is *epistemê* in Greek, is translated from *scientia* in Latin.
- We need a new science of looking at knowledge and information; we also need a new art of learning.
- Problem-based approaches are about learning to confront an ill-structured situation – a situation where we are uncertain about data, information and solution – and mastering the art of intuitive leap.

Conclusion

- The Greek word for dialogue is *dia-logos*. *Logos* refers to the making of meaning.
- PBL is about creating meaningful learning through inquiry and through a rich variety and channels of dialogue.
- In *The Logic of Scientific Discovery*, Popper argued that it is imagination and creativity, not induction, that generate real scientific theories.

The Phantom Tollbooth:
The only failure
is not to try

PBL emphasizes EDV

Engagement

Design of problem
Design of learning environment

Deeper Learning & Understanding

Facilitation of inquiry
Cognitive terrain check

Valued Outcomes

Diversification of learning goals and outcomes
Assessment of cognitive and socio-emotional process