Ubiquitous Learning
環境中的測驗與評量

國立臺南大學 黃國禎
數位學習科技系 教授
資訊教育研究所 所長／理工學院 院長
gjhwang@mail.nutn.edu.tw

Agenda

- Introduction to ubiquitous computing
- Intelligent tutoring and adaptive learning
- How ubiquitous computing benefits learning?
- Minimal Requirements for building a context-aware u-learning environment?
- When should context-aware u-learning be Applied?

Evolution of Learning Environments

- In-class learning
  - Real world
- Computer-Aided Learning (CAL)
  - Computer world
- Web-based Learning (WBL)
  - Cyberspace
- Mobile Learning (M-Learning)
  - Cyberspace + any where access
- Ubiquitous Learning (U-Learning)
  - Cyberspace + any where access + real world

E-Learning

Introduction to Ubiquitous Computing

From Designer View

- Physical integration
  - a ubiquitous computing system involves some integration between computing nodes and the physical world.
- Spontaneous interoperation
  - Communicating components can change both identity and functionality over time as its circumstances change

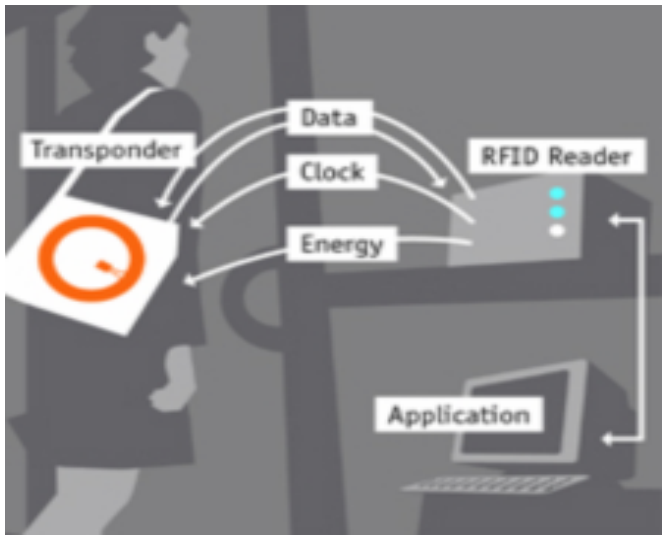
From User View

- Computing with Natural Interfaces
- Context Aware Computing
- Automated Capture and Access to Live Experience
- Everyday Computing
- Social Implication and Evaluation

Computing with Natural Interfaces

- IBM & CITIZEN WatchPad 1.5

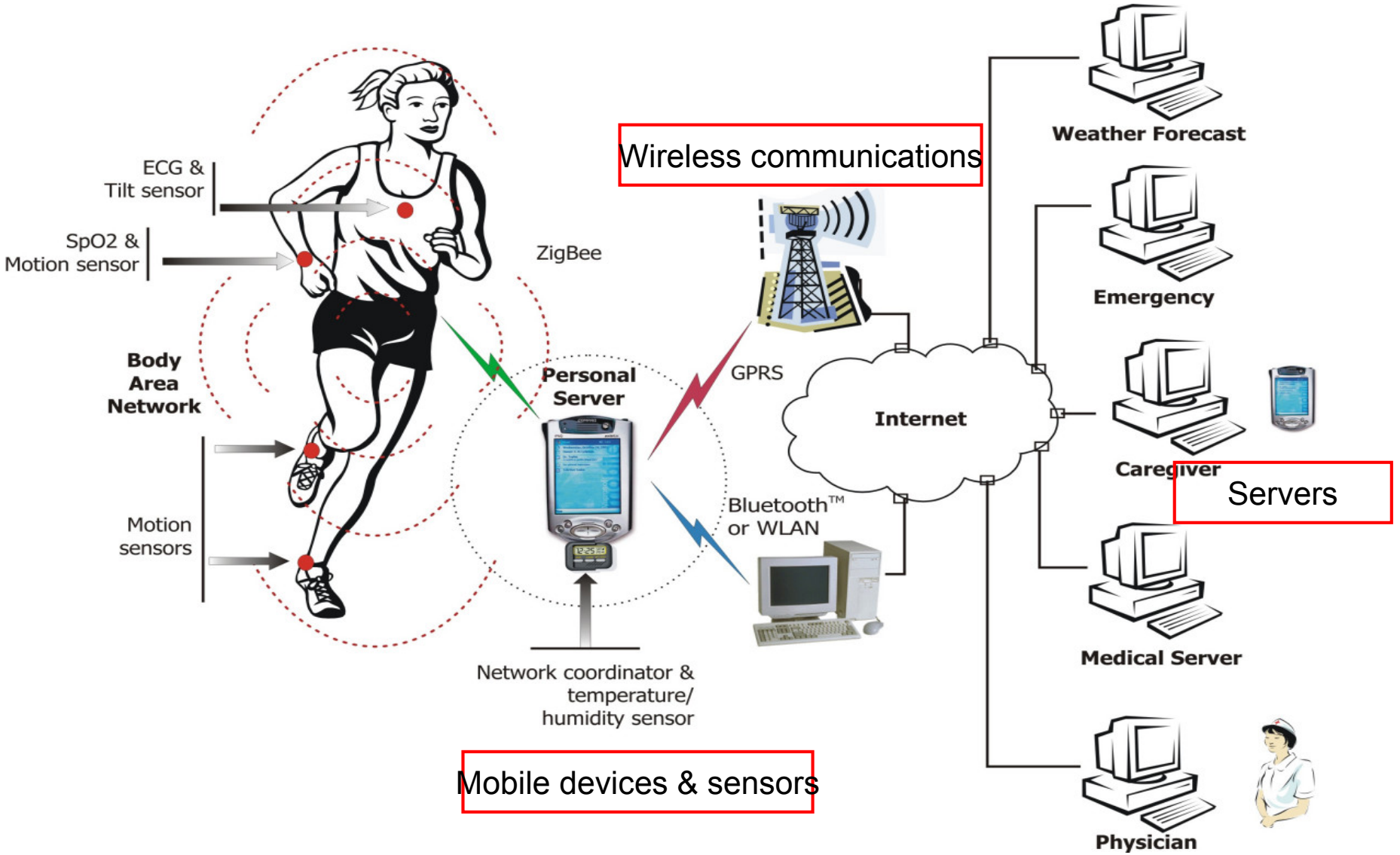
Context Aware Computing



- minimal set of necessary context:
  - *Who* : User and other people in the environment.
  - *When* : User activity relative changes in time.
  - *Where* : The physical location of the user.
  - *What* : Interpretations of user activity.
  - *Why* : Understanding the activity of the user.

Automated Capture and Access to Live Experiences

- Not only trying to remember the important pieces of information
- Tools to support automated capture and access to live experiences
- Remove the burden of doing something humans are not good at (i.e., recording) so that they can focus attention on activities they are good at (i.e., indicating relationships, summarizing, and interpreting).


ECG &
Tilt sensor
SpO2 &
Motion sensor
Body
Area
Network
Motion
sensors
ZigBee
Personal
Server
Network coordinator &
temperature/
humidity sensor
Wireless communications
GPRS
Bluetooth™
or WLAN
Internet
Weather Forecast
Emergency
Caregiver
Medical Server
Physician
Servers
Mobile devices & sensors

Everyday Computing

- Support the informal and unstructured activities of our everyday lives.
- Providing *continuous* interaction moves computing from a localized tool to a constant presence.

  - 以WatchPad或Smartphone來訂火車票、機票、預訂旅館、醫院、或購物

Evolution from M to U is going on

Note: E/M/U-Computing is not specially designed for educational purpose

Intelligent Tutoring & Adaptive Learning

Categories of Relevant Technologies

- Intelligent Tutoring System (ITS) technologies
  - Curriculum sequencing
  - Problem solving support
- Adaptive hypermedia technologies
  - Adaptive navigation support
  - Adaptive presentation
- Web-inspired technologies
  - Student model matching

Curriculum Sequencing

- Also referred to as *Instructional Planning Technology*
- Helps the student to find an "optimal path" through the learning material
- Two levels of sequencing
  - High-level sequencing or *knowledge sequencing*
    - determines next learning subgoal: next concept, set of concepts, topic, or lesson to be taught
  - Low-level sequencing or *task sequencing*
    - determines next learning task (problem, example, test) within current subgoal

E/M to U: Plan curriculum sequencing and guide students to learn in the real world

Problem Solving Support (1)

- Main duty and main value of ITS technology
- Three technologies
  - Intelligent analysis of student solutions
  - Interactive problem solving support
  - Example-based problem solving support

E/M to U: Problems solving scenery moves from virtual world to real world

Problem Solving Support (2)

- Intelligent analysis of student solutions
  - deals with students' final answers
  - decide whether the solution is correct or not
  - find out what exactly is wrong or incomplete
  - identify which missing or incorrect knowledge may be responsible for the error (knowledge diagnosis)
  - provide student with extensive error feedback and update the student model (eg: PROUST [Johnson, 1986])

E/M to U: Problems solving scenery moves from virtual world to real world

Problem Solving Support (3)

- Interactive problem solving support
  - provide intelligent help on each step of problem solving Instead of waiting for the final solution
  - The levels of help vary from signaling about a wrong step, to giving a hint, to executing the next step for the student
  - The systems (often referred to as *interactive tutors*) can watch the actions of the student, understand them, and use this understanding to provide help and to update the student model. (eg: LISP-TUTOR [Anderson, 1985])

E/M to U: Problems solving scenery moves from virtual world to real world

Problem Solving Support (4)

- Example-based problem solving support
  - helping students to solve new problems by suggesting them relevant successful problem solving **cases** from their earlier experience (eg: ELM-PE [Weber, 1996], ELM-ART [Brusilovsky, 1996] and ELM-ART-II [Weber, 1999])

E/M to U: Problems solving scenery moves from virtual world to real world

Adaptive Navigation Support

- Support the student in hyperspace orientation and navigation by **changing the appearance of visible links**
- Has more options than traditional sequencing: it can guide the students both directly and indirectly
- Three most popular ways
  - direct guidance
  - adaptive link annotation
  - adaptive link hiding

E/M to U: Will the behaviors of the student in the real world affect the adaptation of the hypermedia?

Adaptive Presentation

- Adapt the content of a hypermedia page to the user's goals, knowledge and other information stored in the user model
- Pages are not static, but adaptively generated or assembled from pieces for each user
- For example, expert users receive more detailed and deep information, while novices receive more additional explanation

E/M to U: Will the behaviors of the student in the real world affect the presentation of the hypermedia pages?

Student Model Matching

- *adaptive collaboration support*
  - use system's knowledge about different students to form a matching group for different kinds of collaboration
- *intelligent class monitoring*
  - identify the students who have learning records essentially different from those of their peers
  - to find students who need special attention

E/M to U: Do the behaviors of the student in the real world provide useful information?

Introduction to Ubiquitous Learning

How u-computing technologies benefit learning activities?

- A u-computing environment is able to sense personal behaviors in the real world
  - It is able to provide more information to support adaptive learning
  - It is able to guide the learner in the real world
  - It is able to judge the learner's behaviors in the real world is correct
  - It is able to more actively provide necessary information to the learner

Four steps of providing u-learning system services

- Setting instructional requirements for each of the learner’s learning actions
- Detecting the learner's behaviors
- Comparing the requirements with the corresponding learning behaviors
- Providing personal support to the learner

Characteristics of a U-Learning Environment

- Context aware : the learner's situation or the situation of the real-world environment in which the learner is located can be sensed.
- Actively provides personalized supports the right place, and at the right time, based on the personal and environmental situations of the learner in the real world as well as the profile and learning
- Learning anywhere and anytime; that is, the learner is allowed to learn without being interrupted while moving
- Be able to adapt the subject contents to meet the functions of various mobile devices.

U-learning vs M-learning

M-Learning	U-Learning
understands the learner's situation by accessing the on-line database.	In addition to access the on-line database, it is able to sense the learner's situation in the real world.
Learners need to actively access the system via wireless networks.	System can more actively provide personalized information or services to the learners based on real world context
Learning portfolio records the on-line behaviors of the learner.	System can record the real world information of the learner.

More parameters are available in a u-learning environment

- **Personal situation in the real world**: learner's location, time of arrival, temperature, heartbeat, blood pressure, etc.
- **Environmental situation** : the sensor's ID and location, the temperature, humidity, air ingredients, and other parameters of the environment around the sensor
- **Feedback from the sensor** : the sensed values of the target, e.g. PH value of water.
- **Personal data in the database** : learner's profile and learning portfolio, such as the predefined schedule, starting time of a learning activity, the longest and shortest acceptable time period, place, learning sequences.
- **Environmental data in the database** : equipment in the lab, the rules of using the lab, the time table of using the lab

Example 1: Arrange the students to Learn in the real world with on-line guidance

➢**U-learning system:**
Now we are going to learn to identify the TYPE of a plant. Can you see the plant in front of you?
➢**Your Ans:** Yes.
➢**U-learning system:** Can you identify the type of the plant.
> **Your Ans :** No.
> **U-learning system:** What is the color of the plant?
> Your Ans : Green.
> **U-learning system:** Is the plant one trunk?
>Your Ans : No.

Green OK YES NO

Example 2: Evaluate the students by asking them to identify real world objects

➢**U-learning system:**
Now we are going to evaluate your knowledge concerning the TYPE of plants. The time limit of the first test item is 15 minutes. Are you ready?
➢**Your Ans:** Yes.
U-learning system: Find all of the plants with "Herb" type in the campus by clicking the "Confirm" bottom of your learning device while you are in front of the plants.
. . . . . .

YES NO

Example 3: Conduct Real world observations with online information supports

➢**U-learning system:**
Now we are going to learn to recognize the plants in the campus via identifying their features. Can you see the plant in front of you?
➢**Your Ans:** Yes.
U-learning system: Do you know the name of this plant?
> **Your Ans :** No.
> **U-learning system:** Connect to the plant database, which will help you in recognizing the plant. When you are ready to answer this question, click the "Ready" bottom.
.....

YES NO

Example 4: Conduct Cooperative problem solving in the real world with on-line assistance

➢**U-learning system:**
John, now you are in the northern-west area of the campus. You can see the locations of your team members on the screen of the learning device. There is a communication window in the up-right corner of the screen that allows you to communicate with them. What you need to do is to complete the map of the campus by locating each building and avenue in the correct position.

(John walking……..)

U-learning system: The location has been occupied by another building located by Tom. Please check it.

Characteristics of ideal u-learning

- Context aware: At least the location of the student and the environmental parameters of that location can be sensed.
- Active support: The system is able to actively provide personalized guidance for each student.
- Learning in real world: Real world learning and assessment are enabled with on-line supports.
- Seamlessly learning: The u-learning system can provide continuous supports without being interrupted while moving from places to places.

Minimal Requirements for building a context-aware u-learning environment?

- A set of readers (or sensors) that sense the situation (at least location) of the learner (e.g., RFID readers)
- A set of tags that can be used to identify each learner
- A server that can access the user's situation from the readers
- A mobile device that can display the messages from the server

When should context-aware u-learning be applied?

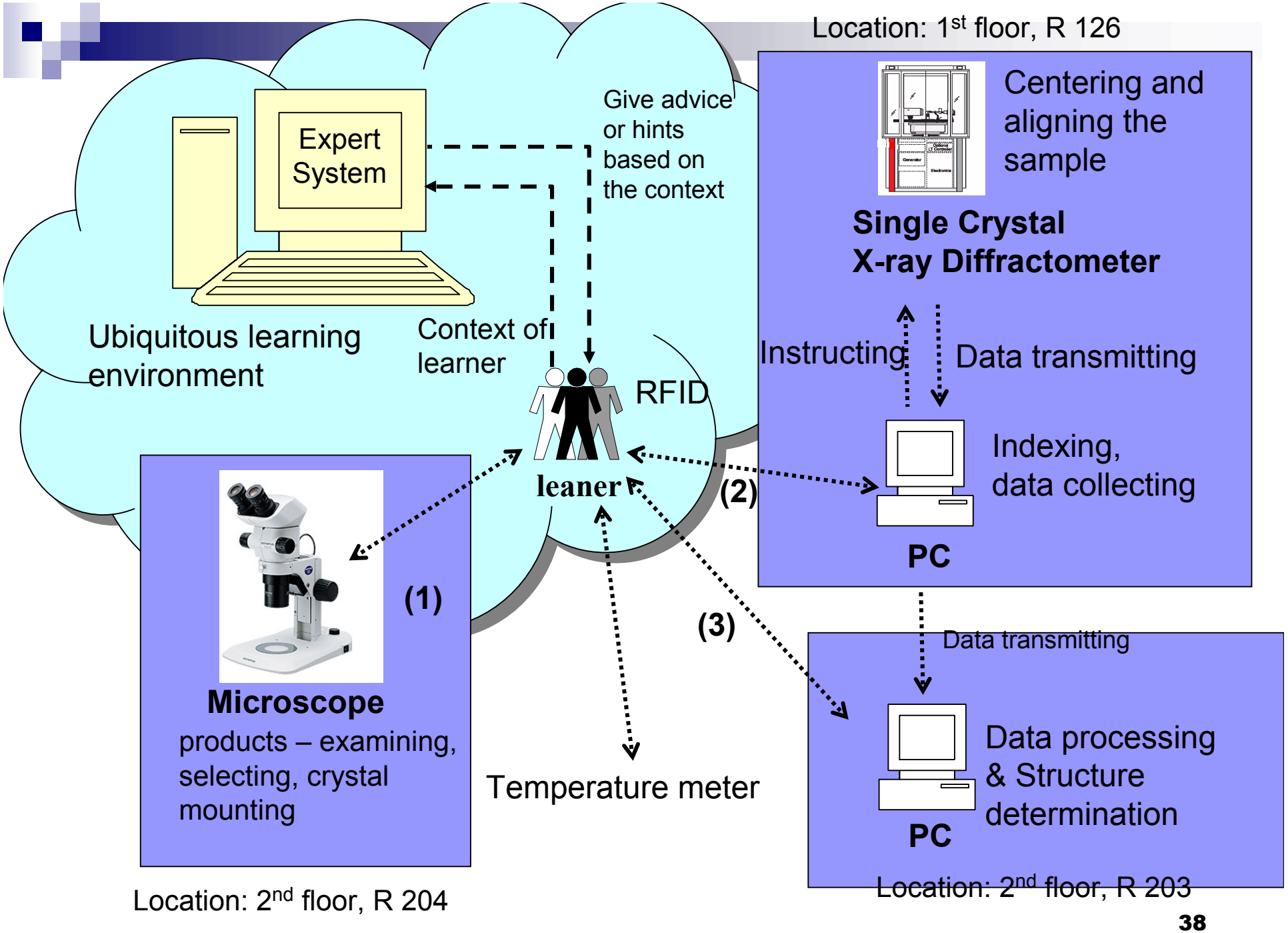
- Do the learners need supports from the system?
- Do we need personalized instructions?
- Do the instructions or supports need to be given actively?
- Do the learners need to move from places to places during the learning process?
- Do the learners need to learn in the real world?
- Does the context (e.g. location or environmental temperature) of the learner affect the learning process?

Three levels of U-Learning

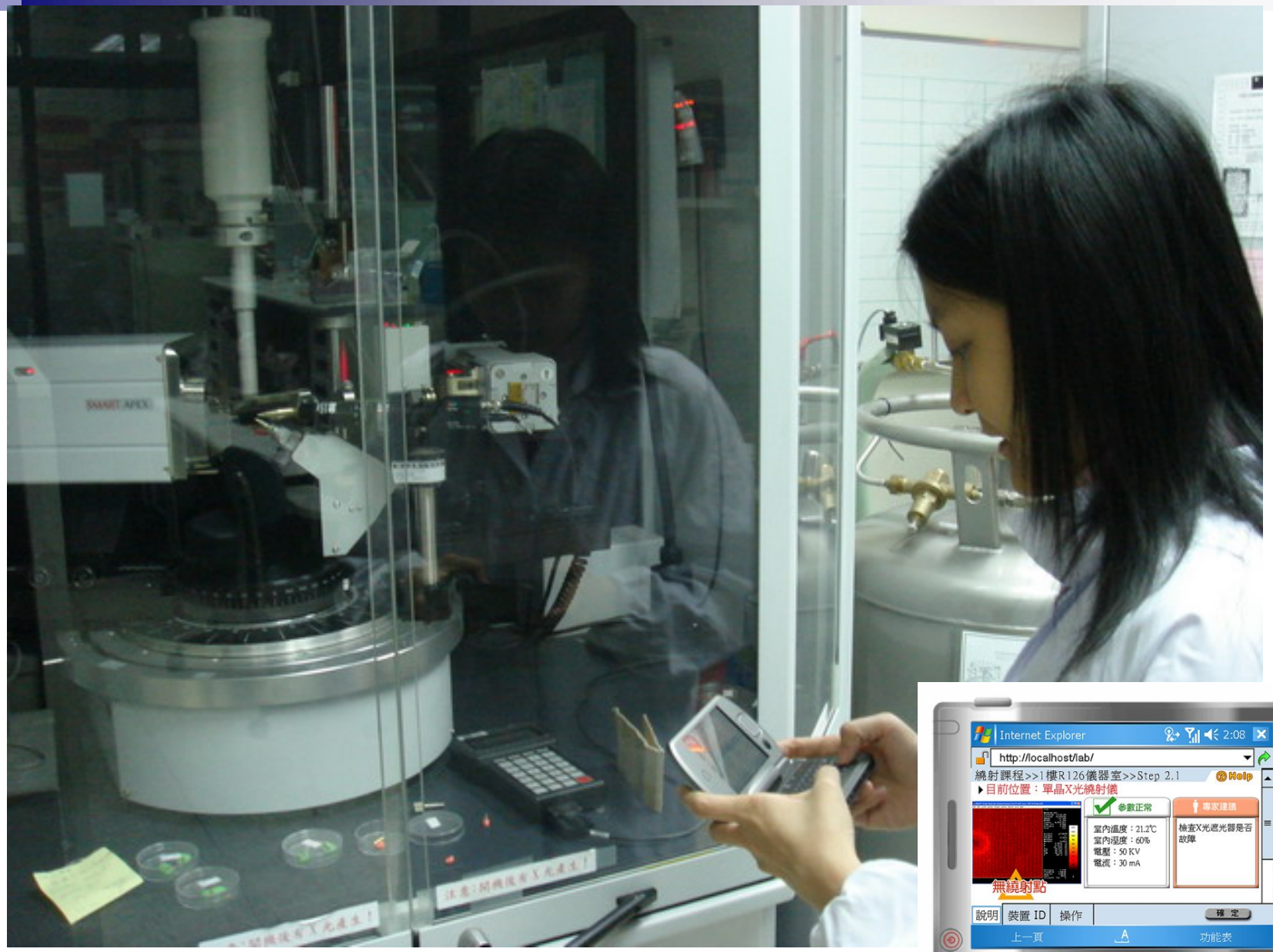
- Provide individualized guidance in real world learning
  - For naive learners
- Provide adaptive supports in real world learning
  - For learners with different backgrounds and experiences
- Provide hints or necessary reminding in real world learning
  - For experienced learners

Case Study on Training Single-Crystal X-ray Diffraction Researchers

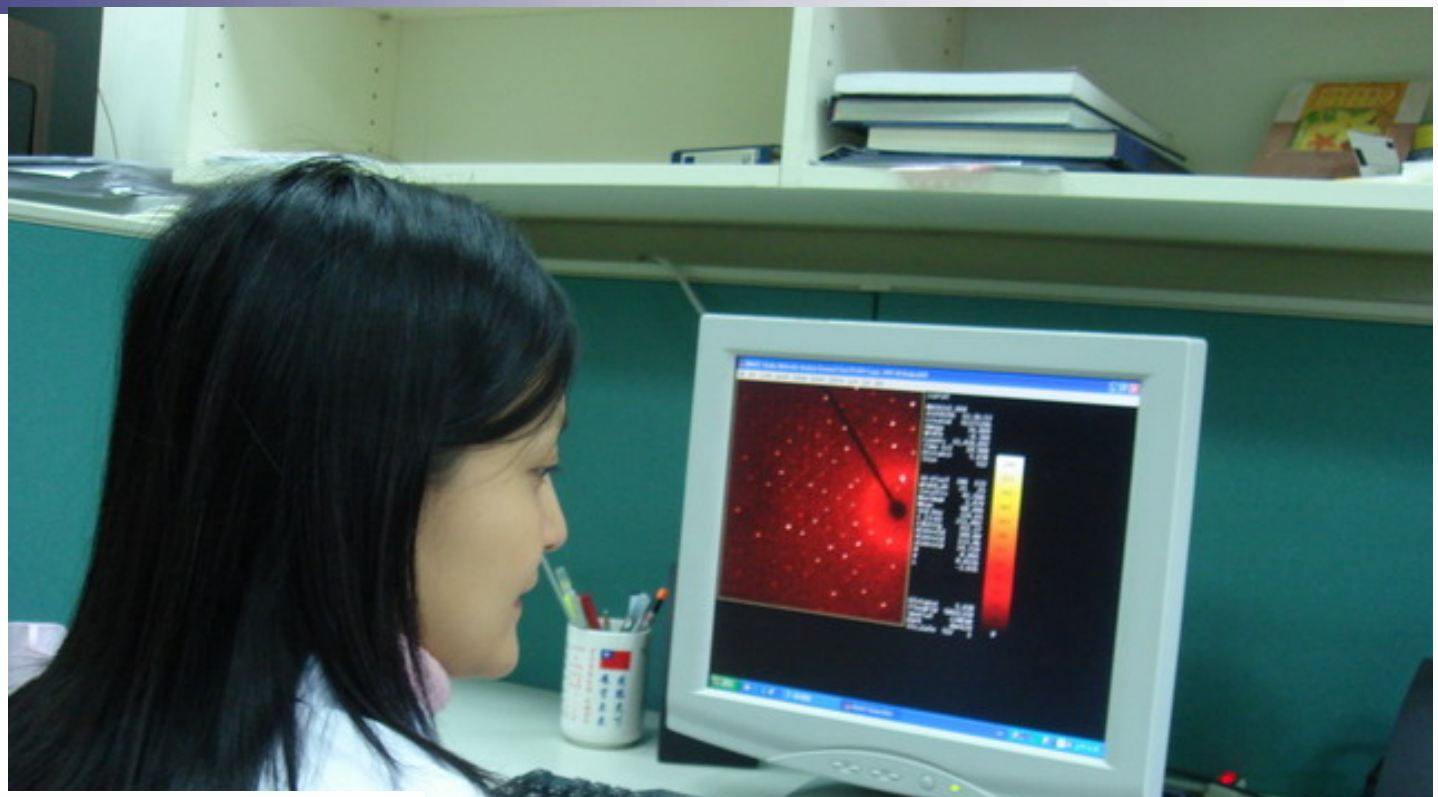
- Single-Crystal X-ray Diffraction is the most effective method for analyzing 3D structure of compound materials
- The researchers need to move from places to places to operate different equipment
- It is time-consuming to train a new researcher (usually 1-2 years)
- The operations could be dangerous, and hence the learner requires full-time guidance during the training process


Location: 1st floor, R 126
Expert System
Give advice or hints based on the context
Ubiquitous learning environment
Context of learner
RFID
leaner
Centering and aligning the sample
Single Crystal X-ray Diffractometer
Instructing
Data transmitting
Indexing, data collecting
PC
(2)
(1)
Microscope
products – examining, selecting, crystal mounting
(3)
Temperature meter
Data transmitting
Data processing & Structure determination
PC
Location: 2nd floor, R 203
Location: 2nd floor, R 204


Internet Explorer
2:08
http://localhost/lab/
繞射課程>>2樓R204實驗室>>Step1.1
Help
判斷晶體品質
單晶
複晶
以在偏光顯微鏡下呈現不同的折射率而分辨
說明
裝置 ID
操作
下一步驟:挑選良好品質晶體
確 定
上一頁
A
功能表



Internet Explorer
2:08
http://localhost/lab/
繞射課程>>1樓R126儀器室>>Step 2.1
Help
目前位置：單晶X光繞射儀
參數正常
專家建議
室內溫度：21.2℃
室內濕度：60%
電壓：50 KV
電流：30 mA
檢查X光遮光器是否故障
無繞射點
說明
裝置 ID
操作
確 定
上一頁
功能表




Internet Explorer
2:08
http://localhost/lab/
繞射課程>>2樓R203研究室>>Step3.1
Help
First input frame name s5010.001
frames to process 30
Max pixel separation 1
Raw count threshold -1
I/Sigma low threshold 20
I/Sigma high threshold 9999.
Minimum excluded X 0.0
Maximum excluded X 30.0
Radius cutoff 512.
1.讀入的繞射數據檔案來源
2.讀入的繞射frame數目
3.所取繞射數據的強度比
繞射點的總數與frame數目成正比，與強度比成反比，繞射點的數目會影響晶格常數的準確度與誤差值
說明
裝置 ID
操作
確 定
上一頁
功能表

Is U-learning equal to "context-aware ubiquitous learning"?

- The criteria of building a fully functional u-learning environment is still undefined.
- The e-learning system can more actively provide more adaptive supports according to the learner's context in the real world.
- The real-world observation and problem-solving abilities can be trained and evaluated in such a context-aware environment.
- Training for operations of a complex procedure could be a good application of u-learning

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Thank You!!