Lifelong learning as a driver for designing pervasive technology.... creating learning technology for the future

Judy Kay
CHAI: Computer Human Adapted Interaction Research Group
School of Information Technologies
University of Sydney
Immediate Past President of the AIED Society

Programme co-Chair ITS2010, General Chair AIED2011, Programme co-Chair Pervasive 2012
• Sisyphean tasks and lifelong learning
• Novel interfaces
• Electronic footprints
• Long term curriculum
• All together
A personal example

Goal: I want to improve my posture
Improve (maintain) posture

• Tell me when I am:
  – Doing the wrong things eg slouching
  – Being too inactive
• Help me find:
  – “Stuff I’ve Seen” about posture
  – new things I can do and be inspired to do them
• Help me to:
  – make a plan
  – Remember to do things I planned to do
  – monitor my performance
  – Revise my plans
• Share parts of my learner model with:
  – a health professionals
  – a friend/buddy with similar goals
  – a community of posture improvers
  – ...
This is a Sisyphean Task
Sisyphus
had to push a rock up a hill
he had to work alone
every day it rolled down as he neared the top

Camus: "The struggle itself [...] is enough to fill a man's heart. One must imagine Sisyphus happy."
Sisyphean tasks are done repeatedly to achieve important *lifelong goals* perhaps without apparent “progress”
Could it be that Sisyphus had trouble detecting his progress?
Another class of Sisyphean tasks
5,000
Learn X to 10,000 hour skill level
Eg X = Programming

• Tell me when I am:
  – Doing the wrong things eg writing spagetti code
  – Being slow in clocking up purposeful practice hours

• Help me find:
  – “Stuff I’ve Seen” about programming well
  – new things I can do be inspired to do them

• Help me to:
  – make a plan
  – Remember to do things I planned to do
  – monitor my performance
  – Revise my plans

• Share parts of my learner model with:
  – a health professionals
  – a friend/buddy with similar goals
  – a community of programmers

...
and examples of really long term tasks
Spaced repetition – to learn and remember **vocabulary**
Spaced repetition – to learn and remember chemistry, maths, .....
How to get there?
A challenging and long journey...

New ways to interact

Trent Apted, Anthony Collins
Computer-human interaction research group
Human body information explorer
Exploring collections of resources
Collaborative maths game
Older users too

New interfaces create possibilities...

... digital footprints
... huge potential for long term modelling
... but ...
Data about me
The challenge of interpretation......
data about me
Exploiting electronic traces – mirrors, navigation tools

Kalina Yacef, Peter Reimann, Kim Upton
We know what we are, but know not what we may be.

Shakespeare
Shakespeare was too generous:

How self-aware are we?
Case Study: learning to collaborate
Have you ever had a frustrating group work experience?
Some problems for groups

• Establishing common ground
• Social loafing (free-riding)
• Tend to focus on action at the cost of
  – Reflection
  – Attending to psychological needs
• Frustration with quality of interaction
• Feel collaboration overhead too high
• Learning group work skills is hard
• Long term collaboration involves complex skills
Context of our work

Semester long capstone software project
Explicit teaching of group work skills ....
Trac: Tool supporting long term group work

Used by team members, facilitators, teachers, some clients
TRAC

- open source tool for supporting software development projects

```
root / rcwu
```

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<th>Last Change</th>
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<td>52</td>
<td>4 months</td>
<td>rcwu:</td>
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</table>

SVN source repository

- Not a learning system but used in a learning context.
Huge amounts of data about the group members and their interactions
Interaction graph - Medium wiki

Team Leader
Interaction diagram

- Same location of people as in activity diagram
- Black is source - blue is sink
Activity mirrors
Each student has consistent colour, clock position
Closer to centre is more work
Logarithmic scale
DOT GRAPH: TICKET

Amount of ticket activity by each student each day
Narcissus

Integrated of mirror tool

Narcissus tab
Group View - SOFT3300 Group x

Group View | Project View | Ticket View

<table>
<thead>
<tr>
<th>Date</th>
<th>member1</th>
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Details
- 19:06 Changeset [77] by member 2
- 19:06 Changeset [78] by member 2
- 20:22 Changeset [79] by member 2
- 20:24 Changeset [80] by member 2
- 20:30 Changeset [81] by member 2

Score
- The following activity was detected:
  - svn add: 78 lines added
  - svn add: 73 lines added
  - svn edit: 3 lines added
- The points for svn are calculated as follows:
  - 1 point for up to 50 added lines
  - 2 points for up to 150 added lines
  - 3 points for up to 300 added lines
  - 4 points for over 300 added lines

Time – activity on that day is shown for each user, on each medium.
Group View - SOFT3300 Group x

Legend:
- wiki
- svn
- ticket

Score:
The following activity was detected:
svn add: 78 lines added
svn add: 73 lines added

Wiki contributions
svn contributions
ticket contributions
Click on cell ... to see details.
Details

19:06 Changeset [77] by member 2
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Explains scoring
Individual summary

Group average

Legend
- wiki
- svn
- ticket

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Computer human adapted interaction research group
Click on ticket activity for a day

Associated details

Click on ticket label
Ticket #31 (closed task: fixed)

Cover Page

Reported by: [Redacted]  Assigned to: [Redacted]
Priority: minor  Milestone: Final Report (Group)
Component: component1  Version: 
Keywords: Cc: 

Description

Components:
- Project title
- Name of group members
- Name of tutor
- Date submitted
- Standard university form for group work

Assigned to [Redacted] as he is the current manager and as such should provide details on the group as a whole.

Attachments

- coversheetMike.jpg (203.6 kB) - added by [Redacted] on 05/12/08 16:17:57.
- Final Coversheet
- FinalCoverSheet.log (203.6 kB) - added by [Redacted] on 05/12/08 16:19:22.
Exploiting electronic traces – EDM
Educational Data Mining

Kalina Yacef, Agathe Merceron, Irena Koprinska, Dilhan Perera, Osmar Zaiane
### Sequence

<table>
<thead>
<tr>
<th>Group</th>
<th>Managers</th>
<th>Developers</th>
<th>Loafers</th>
<th>Others</th>
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<tr>
<td>Group 1</td>
<td>*1</td>
<td>3</td>
<td>1</td>
<td>1</td>
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<tr>
<td>Group 2</td>
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</table>

**Group 1** – 1 person had sequences characteristic of managers. * That person had the manager role

**Group 1** – 3 members had developer activity sequences

**Group 3** – dysfunctional and here we might see why

**Group 5** – another way to be dysfunctional
Long term learning over 3-5 year Degree Programme

Richard Gluga, Tim Lever, Ray Lister
CUSP: >200 degrees, >2000 subjects

Faculties of Engineering and IT, Architecture, Health Sciences, Commerce...
University Degrees & Curriculum Goals
### Attributes from Engineering & IT Graduate Attribute Matrix that are practiced or assessed in this unit.

#### Course Goal/Attribute

<table>
<thead>
<tr>
<th>Course Goal/Attribute</th>
<th>Practiced?</th>
<th>Assessed by?</th>
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</thead>
<tbody>
<tr>
<td>1) Design and Problem Solving Skills (Level 2)</td>
<td>Yes</td>
<td>Assignment (20.00%), Quiz (20.00%), Final Exam (60.00%),</td>
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<tr>
<td>2) Discipline Specific Expertise (Level 2)</td>
<td>Yes</td>
<td>Assignment (20.00%),</td>
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<tr>
<td>Direct equivalents</td>
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<tr>
<td>Knowledge of the major technical areas comprising least one engineering discipline, and competence in applying mathematics, science and engineering science to the analysis and solution of representative problems, situations and challenges in those areas [EStage1: PE1.2a]</td>
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<tr>
<td>Knowledge of materials and resources relevant to the discipline, and their main properties, and ability to select appropriate materials and techniques for particular objectives [EStage1: PE1.2b]</td>
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<tr>
<td>Indirect equivalents</td>
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<td>3) Fundamentals of Science and Engineering (Level 2)</td>
<td>Yes</td>
<td>Quiz (20.00%), Final Exam (60.00%),</td>
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<tr>
<td>4) Information Skills (Level 2)</td>
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<tr>
<td>5) Professional Communication (Level 2)</td>
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<tr>
<td>6) Professional Values, Judgement and Conduct (Level 1)</td>
<td>No</td>
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</table>
## Detailed Program Attribute Assessment - Engineering & IT Graduate Attribute Matrix (or Equivalents)

This report shows a detailed breakdown of attribute assessment data. Note that for Unit Blocks containing electives we take a pessimistic approach and determine the minimum possible assessment weight for each attribute level. This is calculated based on the Unit Block Min CP and Free Elective CP values.

### Level 1

<table>
<thead>
<tr>
<th>Core</th>
<th>Unit</th>
<th>CP</th>
<th>W</th>
<th>CPEW</th>
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Degree level summary of levels and broad areas
# One Accreditation View

## Detailed Program Attribute Assessment - Stage 1 Competency Standards for Professional Engineers (or Equivalents)

This report shows a detailed breakdown of attribute assessment data. Note that for Unit Blocks containing electives we take a pessimistic approach and determine the minimum possible assessment weight for each attribute level. This is calculated based on the Unit Block Min CP and Free Elective CP values.

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<td>PE1.1a: Sound knowledge of mathematics to the level required for fluency in the techniques of analysis and synthesis that are relevant to the broad field of engineering, and to potentially related fields</td>
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### Adv Recommended

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<th>W</th>
<th>CPEW</th>
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### PE1.1b: Sound basic knowledge of the physical sciences, life sciences, and information sciences

<table>
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<tr>
<th>CORE:</th>
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Novel interfaces, EDM, learner model visualisation interfaces, classroom orchestration

Roberto Martinez, Kalina Yacef
Collaboration has been proven to activate special learning mechanisms that cannot be triggered by working individually.

P. Dillenbourg.

What do you mean by 'collaborative learning'?

Two hands are better than one.

building on others

externalisation

discussion?

affection

argumentation

diverse expertise
Tabletops in classrooms

• This field is in its infancy
• The hardware is developing month to month
• Educators want to “use” them in the classrooms but they still don’t know exactly how.

(i) teachers have several groups
(ii) students need timely feedback on
(iii) tabletops offer new ways to support learning
(iv) and the potential to capture and use traces of the interaction

Background image from: AlAgha, I., et al. Towards a teacher-centric approach for multi-touch surfaces in classrooms. in Interactive Tabletops and Surfaces. 2010: ACM.
The collaborative task
(concept mapping and problem solving)

• Concept mapping is:
  – A tool for externalising knowledge
  – Applied in different domains
  – Promotes meaningful learning
  – Has been used by organisations such as NASA, Navy, and universities around the world.

To help teachers determine whether groups or individual learners need attention.
Class level: Indicator of detected collaboration.

• A Best-First tree model trained in another dataset classifies each block 30 seconds of activity.

Features:
• # of active participants in verbal discussions,
• amount of speech,
• number of touches
• symmetry of activity (Gini coefficient).

• Labels: Collaborative, Non-collaborative, or Average.

• The visualisation shows the accumulation of these.

Class level: Graph of interaction with others’ objects

- The Circles indicate the number of touches
- The Lines represent the number of actions that each learner performed on others’ links and concepts

Group 1

Group 2

Group 3
Class level: Mixed radar of participation

- Symmetry of physical participation
- Symmetry of verbal participation
- The closer the corner of the triangle to the centre the less participative the student
Group level: *Evolution of the group map and Timeline of interaction with other learners’ objects*

A group where student in RED is doing very little

A group where the three students worked separately

![Graphs showing interaction timeline for Alice, Bob, Carl, David, Sophie, and Alicia](image-url)
Classroom Orchestration
To help teachers to control multiple classroom tutorial sessions.
The image shows a tablet screen with various buttons and data charts. The buttons include:
- Start All
- Next Phase
- Block all
- Unblock all
- Send Message

There is a timer indicating "2 minutes to finish." The screen also displays the session number as "Session: 23." At the bottom, there is a red "RESET" button.

The data charts on the right side of the screen are labeled:
- Blue table-23
- Yellow table-23
- Green table-23
- Red table-23

The charts show bar graphs with different colors for each chart.
Summary
• Sisyphean tasks and lifelong learning
• Novel interfaces
• Electronic footprints
• Long term curriculum
• All together

http://wikilivres.info/wiki/index.php/The_Little_Prince
Acknowledgements
Embedded, mobile UIs

OLMs, Scrutiny UIs

EDM

Acknowledgements

Software infrastructure user control, scrutability
Acknowledgements
Questions?

Please visit CHAI at chai.it.usyd.edu.au
This talk presents a vision for lifelong learning as a driver for designing pervasive technologies. It does this via case studies for challenging long-term learning goals associated with health and wellness, collaboration to learn and learning to collaborate.

One strand of that vision involves the new learning interfaces across each learner's personal digital ecosystem of devices, ranging from mobiles, to desktops and embedded interactive surfaces on walls and tables. A second strand concerns the huge amounts of data that these devices can, and do, capture about learners. This takes diverse forms, including personal information, learning data and digital footprints. There is a huge and growing amount of this data. It lives across the personal digital ecosystem, on personal devices and in the cloud.

The talk illustrates the design of technologies to give this data to the learner at three levels. One concerns learner control over the capture and use of their data. Another involves data mining to transform it into new insights for the learner, their teachers and facilitators, and for education researchers. The final one is the design of interfaces such as in Open Learner Models to scaffold the learner's metacognitive activities of self-monitoring, self-reflection and planning.