Microsoft® Research
Faculty Summit 2011
Cartagena, Colombia | May 18-20 | In partnership with COLCIENCIAS
Nelson Baloian

Bridging the gap between formal and informal learning: the HCI perspective
Laccir Project: Research Goals

- Discover meaningful learning scenarios where the “information loop” applies
- Develop the necessary learning support tools
- Implement a **coherent, unified** HCI across various platforms/applications
Some “very old” story

- 1993 IPSI-GMD Darmstadt, (.de) receives 2 electronic boards
- Streitz : DOLPHIN
  - Ambiente: the disappearing computer
- Hoppe : Cosoft
  - The Coputer-integrated Classroom
- 1995 : Duisburg, COLLIDE:
  - Collaborative Learning in Intelligent Distributed Environments
- Bring the computer into the classroom
Rich teacher-student & student-student interaction

Merging of Various Media
The Nimmis Classroom (1999-2002)

- Goals:
  - Computers supporting reading/writing learning in the classroom
  - Embedded technology
  - “Reading through writing” methodology
- Challenges:
  - File Manager?
  - Login Procedure?
Back in Chile

- 2003 Teaching Java with interactive board
- Using "Off-the-shelf" software
Teaching Java with “Off the shelf” software

- **Power point presentation**

---

**Otras formas de escribir ciclos**

- **while loop**
  ```java
  int i = 1;
  while (i <= 10) {
    c.println("5 X " + i + " = " + i*5)
    i = i + 1;
  }
  ```

- **do while loop**
  ```java
  int i = 1;
  do {
    c.println("5 X " + i + " = " + i*5)
    i = i + 1;
  } while (i <= 10);
  ```

- **for loop**
  ```java
  for (i = 1; i <= 10; i = i+1)
  c.println("5 X " + i + " = " + i*5);```

---

**Teaching Java with “Off the shelf” software**

- **Power point presentation**

---

**Otras formas de escribir ciclos**

- **while loop**
  ```java
  int i = 1;
  while (i <= 10) {
    c.println("5 X " + i + " = " + i*5)
    i = i + 1;
  }
  ```

- **do while loop**
  ```java
  int i = 1;
  do {
    c.println("5 X " + i + " = " + i*5)
    i = i + 1;
  } while (i <= 10);
  ```

- **for loop**
  ```java
  for (i = 1; i <= 10; i = i+1)
  c.println("5 X " + i + " = " + i*5);```

---

**Teaching Java with “Off the shelf” software**

- **Power point presentation**

---

**Otras formas de escribir ciclos**

- **while loop**
  ```java
  int i = 1;
  while (i <= 10) {
    c.println("5 X " + i + " = " + i*5)
    i = i + 1;
  }
  ```

- **do while loop**
  ```java
  int i = 1;
  do {
    c.println("5 X " + i + " = " + i*5)
    i = i + 1;
  } while (i <= 10);
  ```

- **for loop**
  ```java
  for (i = 1; i <= 10; i = i+1)
  c.println("5 X " + i + " = " + i*5);```

---

**Teaching Java with “Off the shelf” software**

- **Power point presentation**

---

**Otras formas de escribir ciclos**

- **while loop**
  ```java
  int i = 1;
  while (i <= 10) {
    c.println("5 X " + i + " = " + i*5)
    i = i + 1;
  }
  ```

- **do while loop**
  ```java
  int i = 1;
  do {
    c.println("5 X " + i + " = " + i*5)
    i = i + 1;
  } while (i <= 10);
  ```

- **for loop**
  ```java
  for (i = 1; i <= 10; i = i+1)
  c.println("5 X " + i + " = " + i*5);```

---

**Teaching Java with “Off the shelf” software**

- **Power point presentation**

---

**Otras formas de escribir ciclos**

- **while loop**
  ```java
  int i = 1;
  while (i <= 10) {
    c.println("5 X " + i + " = " + i*5)
    i = i + 1;
  }
  ```

- **do while loop**
  ```java
  int i = 1;
  do {
    c.println("5 X " + i + " = " + i*5)
    i = i + 1;
  } while (i <= 10);
  ```

- **for loop**
  ```java
  for (i = 1; i <= 10; i = i+1)
  c.println("5 X " + i + " = " + i*5);```

---

**Teaching Java with “Off the shelf” software**

- **Power point presentation**

---

**Otras formas de escribir ciclos**

- **while loop**
  ```java
  int i = 1;
  while (i <= 10) {
    c.println("5 X " + i + " = " + i*5)
    i = i + 1;
  }
  ```

- **do while loop**
  ```java
  int i = 1;
  do {
    c.println("5 X " + i + " = " + i*5)
    i = i + 1;
  } while (i <= 10);
  ```

- **for loop**
  ```java
  for (i = 1; i <= 10; i = i+1)
  c.println("5 X " + i + " = " + i*5);```

---

**Teaching Java with “Off the shelf” software**

- **Power point presentation**

---

**Otras formas de escribir ciclos**

- **while loop**
  ```java
  int i = 1;
  while (i <= 10) {
    c.println("5 X " + i + " = " + i*5)
    i = i + 1;
  }
  ```

- **do while loop**
  ```java
  int i = 1;
  do {
    c.println("5 X " + i + " = " + i*5)
    i = i + 1;
  } while (i <= 10);
  ```

- **for loop**
  ```java
  for (i = 1; i <= 10; i = i+1)
  c.println("5 X " + i + " = " + i*5);```

---

**Teaching Java with “Off the shelf” software**

- **Power point presentation**

---

**Otras formas de escribir ciclos**

- **while loop**
  ```java
  int i = 1;
  while (i <= 10) {
    c.println("5 X " + i + " = " + i*5)
    i = i + 1;
  }
  ```

- **do while loop**
  ```java
  int i = 1;
  do {
    c.println("5 X " + i + " = " + i*5)
    i = i + 1;
  } while (i <= 10);
  ```

- **for loop**
  ```java
  for (i = 1; i <= 10; i = i+1)
  c.println("5 X " + i + " = " + i*5);```

---

**Teaching Java with “Off the shelf” software**

- **Power point presentation**

---

**Otras formas de escribir ciclos**

- **while loop**
  ```java
  int i = 1;
  while (i <= 10) {
    c.println("5 X " + i + " = " + i*5)
    i = i + 1;
  }
  ```

- **do while loop**
  ```java
  int i = 1;
  do {
    c.println("5 X " + i + " = " + i*5)
    i = i + 1;
  } while (i <= 10);
  ```

- **for loop**
  ```java
  for (i = 1; i <= 10; i = i+1)
  c.println("5 X " + i + " = " + i*5);```
Teaching Java with “Off the shelf” software

Power point presentation

Text editor

Otras formas

- while loop
  ```java
  int i = 1;
  while (i <= 10) {
    c.println("5 X " + i + " = " + (i * 5));
    i = i + 1;
  }
  ```

- do while loop
  ```java
  int i = 1;
  do {
    c.println("5 X " + i + " = " + (i * 5));
    i = i + 1;
  } while (i <= 10);
  ```

- for loop
  ```java
  for (i = 1; i <= 10; i++)
    c.println("5 X " + i + " = " + (i * 5));
  ```

- public class Program9 {
  ```java
  public static void main(String args[]) {
    int a, max, min, sum;
    x.print("Ingrese el primer numero: ");
    a = x.readInt();
    max = a; min = a; sum = a;
    int i = 1;
    while (i < 1000) {
      x.print("Ingrese el "+(i+1)+"-simo numero: ");
      a = x.readInt();
      sum = sum + a;
      if (a > max)
        max = a;
      if (a < min)
        min = a;
      i = i + 1; // you can also write i++
    }
    x.println("El máximo es: "+max);
    x.println("El mínimo es: "+min);
    x.println("El promedio es: "+(sum)/i);
  }
  ```
Teaching Java with “Off the shelf” software

- Power point presentation
- Text editor
- System Console

```
public class Program9 {
    public static void main(String args[]) {
        int a, max, min, sum;
        Console x = new Console();
        x.print("Ingresé el primer número: ");
        int a;
        sum = a;
        int i = 1;
        while (i <= 10) {
            // Code...
        }
        // Code...
    }
}
```
Teaching Java with “Off the shelf” software

Power point presentation

System Console

Text editor

File system browser
In the best case:

Power point presentation

I.D.E

File system browser
• “The teacher simply spends too much time trying to show us things”
• “We get easily distracted in class”
• “I started to take some books with me and began to read them there. Finally I quit attending classes”,
• “Why does it take so much time to move from one program to another?”
• Focus of attention & Students’ Distraction problems
Motivation for the CIC Project (2004)

- Integrates presentation, program editing/running and handwriting
- Synchronization
- Automatic distribution & collection of files for most frequent tasks

Testing in a real scenario (U. of Waseda 2005)

<table>
<thead>
<tr>
<th>Category</th>
<th>Standard scenario</th>
<th>CiC scenario</th>
<th>Chi-square</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preparation</td>
<td>2.21</td>
<td>1.81</td>
<td>2.655</td>
<td>0.265</td>
</tr>
<tr>
<td>Presentation</td>
<td>1.67</td>
<td>2.33</td>
<td>6.644</td>
<td>0.036</td>
</tr>
<tr>
<td>Flexibility</td>
<td>1.67</td>
<td>2.60</td>
<td>14.952</td>
<td>0.001</td>
</tr>
<tr>
<td>Highlighting</td>
<td>2.31</td>
<td>2.43</td>
<td>4.079</td>
<td>0.453</td>
</tr>
<tr>
<td>Absence of Disruption</td>
<td>1.57</td>
<td>2.24</td>
<td>12.868</td>
<td>0.002</td>
</tr>
<tr>
<td>Follow-Up</td>
<td>1.71</td>
<td>2.26</td>
<td>9.172</td>
<td>0.10</td>
</tr>
</tbody>
</table>
• HCI matters in learning scenarios
• Minimize interaction time
• Unexpected collaborative learning situations

• Good for a particular situation -> students’ efforts might not be rewarding
• “Set-up” time too long
Deep Board: exploring gesture-based interaction

- **Goals:**
  - Minimize preparation time
  - Keep it easy to use, easy to remember
  - Allow Flexible creation, structuring & presentation of learning content

- **How:**
  - Gesture-based commands
  - Implementing “depth” with interactive whiteboards
  - Web-based, collaborative
Lessons Learned

• Keep it **simple**
  • Simple structure of material
  • Simple HCI, easy to remember
• Pages are not the only simple, easy to remember information **structure:**
  • **3D** information graphs: easy to manage
• Supporting **remote** lectures between two campuses at Waseda Univ. in Japan
• Still **being used** !!

Mobile Collaborative Learning

- 2005: Mobile technology is mature enough to support learning

- Idea: use gesture-based interaction for mobile devices
  - Natural way to interact with a PDA
  - “Expand” screen capabilities (deep board)

- Other opportunities:
  - Keep rich face-to-face interaction while using computers
  - Dynamic group formation/reconfiguration

First Development: Mobile Collaborative Sketching

- Supporting **collaborative** design in learning scenarios
- Take a picture and start **generating ideas** by sketching
- Full Synchronized **P2P** application
- Interaction based almost exclusively on **gestures**
  - Maximizing available workspace.
- Content organized as hierarchical **concept maps**
- **No switching** between sketching and gesturing
Dark margin means working in an inner sub-node.

Highlighted “Session” Text means work needs to be saved.

“Document three” icon

Design spots are anchors to other sketching pages.

The “group” icon shows % of users working in this node.
MCSketcher’s Tree view: 2 Examples

A Framework for developing mobile applications

Many mobile collaborative learning/working scenarios share common characteristics & have similar requirements

- Gestures recognition module
  - Recognizes some gestures
  - Extendable to add more gestures

- A flexible, lightweight communication platform for peer-to-peer applications
The Middleware

- API for developing distributed P2P applications easily.
- Available in Java and C#.
- Implemets object conversion:

- Provides services for discovering partners and establishing connections.

Diagram:

- Marshaling
- Unmarshaling
- XML

Diagram:

- Mobile devices
- Connections
- Question mark
Gesture support (examples)

Selecting

Deleting

Resizing, rotating
Example 1: MCPresenter

Supports:

• Configuring various working groups
• Creating/modifying & sending problems to the groups
• Open answers or options
• Students collaboratively solve problems & send answers back
• Real time monitoring and assessment
System Architecture

Teacher

(Re)Configures groups

Sends problems

Monitors/Assesses

Group 1

Group 2

Group 3

Work together
Group Configuration

- Dragging user Nelson to group 2
- Users are displayed automatically when discovered
- Groups are defined by teacher
- The group icon shows updated content of the group’s shared workspace
Problem creation

Freehand writing/sketching & delimiting elements by a rectangle gesture

Dragging elements to corresponding areas: problem, solution, wrong options
Synchronized work

- Students work synchronously preparing open answers
- Teacher may join a group to help or propose new problems
- Students must agree on an option as the correct answer before sending it
The teacher’s view of results

- **Group 1:** 2 correct answers (1 open, 1 with options)
- **Group 2:** 1 wrong and 1 correct, both with options
- **Group 3:** 2 correct answers (with options) 1 wrong answer (open)

Example 2: Participatory simulations (3)

- **Role-playing** activity oriented towards learning complex & dynamic systems
  - Mapping real world problems to simulated context & behaviors
  - Knowledge & patterns emerge from local interactions

- Highly **effective** in large groups
  - Simple to set up & interact with
  - Analyze information, exchange information, make decisions, see outcomes
  - Allows to relate actions & their consequences

- Highly **motivating** even in large groups
  - Participation & collaboration increase the understanding
  - Whole classroom?
a) Trust building scenario

- Roles: Buyers and sellers
- Exchanging goods with random failures
- Vendor might decide its replacement (maximize revenues!)
b) Medical scenario

- Roles: doctors and patients
- Items: diseases, symptoms and treatments (medicines)
Exchanging Items: Proximity + IrDA
c) Stock Market scenario

So far, so good?

- Not quite:
  - Fragmentation of learning experiences with different tools in different contexts
  - Different interaction rules in each application
  - Briggs:
    - “potential users will adapt technology if its benefits outweigh its disadvantages (notably, the cost of learning how to use it), adjusted by the frequency of use”

- LACCIR Project proposal:
  - Integration of classroom activities (structured, formal) & learning “in the wild” (unstructured, possibly informal and/or unexpected)
Research Questions

• Can we implement meaningful learning activities with this model?
• Can we develop an integrated HCI model across platforms?
• Can we (should we) use widgets? gestures? both?
• Can we describe them with a pattern language?
Example 3: Learning with Patterns

- Pattern: a typical solution for a recurrent problem
- Teacher explains a pattern (components)
- Students go “out” to collect examples
- Process the gathered material at home
- Show, share their findings in the classroom.
- Motivates new “field trips”
System Functionality

- **Creating Patterns:**
  - Teacher, classroom

- **Instantiating patterns:**
  - Students, outside

- **Linking patterns:**
  - Students, anywhere

- **Sharing patterns and instantiations:**
  - Teacher, classroom, students on the field

- **Comparing patterns:**
  - Students, teacher anywhere
System Architecture: Synchronization

Database implementing tuple-spaces

Platform implementing P2P network and Shared Objects

Students working in classroom: tuple spaces

Teacher sharing patterns in classroom: tuple spaces

Student transferring session data to repository: tuple spaces

Students working on the field: Shared Objects

Nelson Baloian, José A. Pino, Gustavo Zurita, Gabriel Peña. Learning with Patterns: an Effective Way to Implement Computer Supported Pervasive Learning 14th (CSCWD), pp. 677-682, Apr 2010. Shanghai, China, Best Paper award
Including Geo-collaboration

- Geo-referenced data plays an important role for completing the task:
- Learning Scenarios:
  - Geology
  - Botany
  - Architecture
  - Languages
  - Social sciences
  - etc.
Task Creation: follow a certain path

Pattern creation: define components
Towards a formal evaluation of gestures

- Which gesture is **good** on which platform?
- **Diverse** Platforms: diverse screen sizes, interaction sensitivities
- What is **good**: easy to learn, easy to remember, robust
Various modes for gesture-based commands

<table>
<thead>
<tr>
<th></th>
<th>Mode 1: certain sketches are recognized as commands</th>
<th>Mode 2: using a pre-gesture (could be double-click)</th>
<th>Mode 3: Depend on starting absolute position</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Multiple selection</strong></td>
<td><img src="image1" alt="Diagram" /></td>
<td><img src="image2" alt="Diagram" /></td>
<td><img src="image3" alt="Diagram" /></td>
</tr>
<tr>
<td><strong>Delete</strong></td>
<td><img src="image4" alt="Diagram" /></td>
<td><img src="image5" alt="Diagram" /></td>
<td><img src="image6" alt="Diagram" /></td>
</tr>
<tr>
<td><strong>Undo/Redo</strong></td>
<td><img src="image7" alt="Diagram" /></td>
<td><img src="image8" alt="Diagram" /></td>
<td><img src="image9" alt="Diagram" /></td>
</tr>
<tr>
<td><strong>Scroll</strong></td>
<td><img src="image10" alt="Diagram" /></td>
<td><img src="image11" alt="Diagram" /></td>
<td><img src="image12" alt="Diagram" /></td>
</tr>
<tr>
<td><strong>Copy/Paste</strong></td>
<td><img src="image13" alt="Diagram" /></td>
<td><img src="image14" alt="Diagram" /></td>
<td><img src="image15" alt="Diagram" /></td>
</tr>
</tbody>
</table>
Which type of result should we look for?

• This just for **one** touch sensitive device
Where do we go from now?

- Even more diverse mobile and non-mobile devices appear every day in the market
  - They differ in shapes, sizes & OS
  - How to develop one platform for all?
- Is 100% P2P really necessary nowadays?
  - Internet is everywhere, and fast
- We are trying HTML5
Example 1: Web-based Geo-collaboration

Private pages
Drag to add
Public Page
Example 2: Modeling TV signals propagation

- Various models, various purposes
- Which model fits better to which situation?
- Which arrangement of antennas covers more population?

1- Prepare data
   Make simulations
   Store results

2- Retrieve data
   Measure signal strength
   Compare results

3- Present results
   Correct assumptions
Position of antennas, chose model

Simulation of covered area

Step 1: Search in the 2D Map the position of the transmitter and set it in the 3D Map (double click).
Step 2: Set parameters.
Step 3: Add the transmitter, select it and evaluate on 360°
Working on the field

- HTML5-based web page allows:
  - Get device position (GPS)
  - Get the signal strength according to each selected model
  - Compare it with the actual length measured with ad-hoc equipment
Conclusions:

• Can we implement meaningful learning activities with this model?
  • Yes, we can!
• Can we (should we) use widgets? gestures? both?
  • Yes, we can!
• Can we develop an integrated interaction model across platforms?
  • Yes, we can (it seems)!
• Can we describe them with a pattern language?
  • Well, we still have to work on this
Thank You

Briging the gap between formal and informal learning