Attitudes towards Computer Science –
Computing Experiences as a Starting Point and Barrier to Computer Science

Maria Knobelsdorf, Carsten Schulte
Institute of Computer Science
September 15, 2007
Introduction

Problem
Students have wrong, limited or inadequate conceptions about the subject matter of computer science

In our Research project we

- investigate students’ attitudes towards Computer Science
- aim at understanding the role and impact of prior experiences
- focus on computing as a starting point or a barrier to CS
Research Background

Relevance of prior experiences for teaching and learning:

**Educational Research**

- Conceptual Change Theory
- Attribution Theory

Prior experiences as processes in the course of life:

**Biographical Research**

- self-creation, coherence-creation and interaction
- analytical point of view on the holistic biographical learning process
Computer-Biographies

data collecting method: computer-biographies

• Participants are asked to write down their biography of computing:

“In 1990 I was playing Tetris, and games like that, with our computer. At that time I’d already started to catalogue my comic collection on the computer. I started learning from my father and later by working things out for myself. From the very beginning I was mesmerised by the infinite possible applications of PCs. At school I had computing lessons with a teacher who we could have taught more than he could teach us. My biggest motivations were always playing games and finding out new possibilities with the computer.”

(male, born in 1983)
Research Method: Data Analysis

Motivation → Computing Experiences → Self-Image

Self-Image:
Confidence, perceptions of one’s own skills and position to CS

World-Image:
notion of computing and Computer Science

Habits:
Patterns of computing and of problem solving

Attitudes towards Computing and Computer Science
The Study

Sample

• user-group
  CS unaffiliated students, 44 biographies of psychology students
  (39 women, 5 men)

• design-group
  CS affiliated students, 89 biographies of CS freshmen
  (72 men, 17 women)

use and design as two opposed modes of computing

Computing

Individually perceived as...

...Use
  • inferior
  • depending
  • being outside
  • passive

...Design
  • superior
  • independent
  • being inside
  • active
Analysis Questions

- CS Unaffiliated/Affiliated students
- use/design and outside/inside
- Transition/ transitorial process

1. Reconstruction of affiliated and unaffiliated students’ biographies:
   How do students of both groups perceive themselves according to the oppositions of use ↔ design and outside ↔ inside?

2. Reconstruction of affiliated and unaffiliated students’ conceptual changes:
   Are there transitorial processes according to use ↔ design and outside ↔ inside?

3. Reconstruction of pathways into and barriers to CS:
   What are the pathways into and barriers to CS?
Reconstruction of Students’ Biographies

<table>
<thead>
<tr>
<th>Unaffiliated Students</th>
<th>Affiliated Students</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>World-Image</strong></td>
<td></td>
</tr>
<tr>
<td>- Computer is a tool</td>
<td>- Computer is a special toy</td>
</tr>
<tr>
<td>- use and prof. use</td>
<td>- use, prof. use, design</td>
</tr>
<tr>
<td><strong>Self-Image</strong></td>
<td></td>
</tr>
<tr>
<td>- Inferior</td>
<td>- Superior</td>
</tr>
<tr>
<td>- Outsider</td>
<td>- Insider</td>
</tr>
<tr>
<td><strong>Habits</strong></td>
<td></td>
</tr>
<tr>
<td>- Defensive</td>
<td>- Expansive</td>
</tr>
<tr>
<td>- Passive</td>
<td>- Active</td>
</tr>
</tbody>
</table>
Reconstruction of Transitorial Processes

Worldview and transition process of unaffiliated and affiliated students

“Special” skills needed

Professional Use

Use

Transition

Design

World-Image of unaffiliated students

World-Image of affiliated students
### Reconstruction of Pathways and Barriers

<table>
<thead>
<tr>
<th>Barriers for unaffiliated students</th>
<th>Pathways of affiliated students</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Attribution</strong></td>
<td></td>
</tr>
<tr>
<td>• Perceiving one’s own skills as</td>
<td>• Perceiving one’s own skills as</td>
</tr>
<tr>
<td>insufficient for learning CS</td>
<td>sufficient for learning CS</td>
</tr>
<tr>
<td>• Perceiving CS as field which</td>
<td></td>
</tr>
<tr>
<td>can not be learned like other</td>
<td></td>
</tr>
<tr>
<td>subjects</td>
<td></td>
</tr>
<tr>
<td><strong>Habits (“learning mode”)</strong></td>
<td></td>
</tr>
<tr>
<td>• Defensive learning</td>
<td>• Expansive learning</td>
</tr>
<tr>
<td>• “Ask for help” problem solving</td>
<td>• Exploratory problem solving</td>
</tr>
<tr>
<td><strong>Preconceptions</strong></td>
<td></td>
</tr>
<tr>
<td>• Perceiving CS as domain of</td>
<td>• Do not see boundaries between</td>
</tr>
<tr>
<td>professional use of computers</td>
<td>use, design and professional</td>
</tr>
<tr>
<td>• Problems in understanding the</td>
<td>use.</td>
</tr>
<tr>
<td>role of programming: what</td>
<td>• If boundaries are seen, they</td>
</tr>
<tr>
<td>programming is, why it is needed</td>
<td>are estimated as unimportant</td>
</tr>
<tr>
<td>and how it is useful</td>
<td>or easy to cross.</td>
</tr>
<tr>
<td></td>
<td>• Experiencing programming as</td>
</tr>
<tr>
<td></td>
<td>another type of interacting with</td>
</tr>
<tr>
<td></td>
<td>the computer.</td>
</tr>
</tbody>
</table>
Conclusions for Teaching Beginners

Reattributional Training

• To be able to solve usage problems
• Success is due to effort and training
• Problems are due to difficult tasks

Reattributional Training and Support of Conceptual Change

“Special” skills needed effort and training

Use

Professional Use

Design

Conceptual Change