Novices’ Expectations and Prior Knowledge of Software Development – Results of a Study with High School Students

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OBJECTIVES / INTERESTS

Constructivism: Prior knowledge affects learning and understanding

- Differences in interests and expectations?
- Interaction between learners’ prior Knowledge
- Preconceptions of software development

DESIGN OF THE STUDY

- Instruments:
  - Questionnaires: Interests, Expectations (from Pilot-Study)
  - Preconceptions of Software development (open question)
  - INCOBI / FIM, CIM (from psychological tests)

- Conducting:
  - Mailing-list: biased group
  - Beginning of grade 11
  - 22 schools, 28 classes, 573 students

- Methods:
  - Factor Analysis
  - Regression Analysis
  - Qualitative ‘content analysis’

HYPOTHESES

- Hypotheses
  - H1: Groups with different interests
  - H2: Different expectations regarding subject matters
  - H3: Different preconceptions of software development
  - H4: Interests and expectations are gender-specific
  - H5: Mutual influences of interests, expectations and preconceptions
  - H6: Influence of computer literacy courses attended at junior high school level

GENDER DIFFERENCES: Interests and Expectations
**GENDER DIFFERENCES:**

**Previous Knowledge, Job-Oriented Motivation**
- **Job-oriented Motivation**
  1. I'm interested in a job related to computer science
  2. I'm interested in a job which includes computer usage

- Knowledge related to Computer usage (4.8 girls, 6.3 boys)
- Motivation to use a computer (CIM: 2.7 girls; 3.0 boys)
- Self-Confidence in computer usage (SUCA: 2.40 girls; 2.95 boys)

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**DIFFERENT EXPECTATIONS REGARDING SUBJECT MATTERS**

- **Type 1** Programming Languages and Software development 
  - 16% (200 m; 8% w)
- **Type 2** Introductory Course, Usage of Computers, Dealing with Social Impacts 
  - 17% (12% m; 26% w)
- **Type 3** Co-operative work in diverse, partly indistinct application 
  - 16% (13% m; 22% w)
- **Type 4** Computer-centred work with few discussions in the group: 
  - 15% (15% m; 16% w)

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**DIFFERENT PRECONCEPTIONS OF SOFTWARE DEVELOPMENT**

**technical**
- Formal
- Parts
- GUI
- Datastructure
- Algorithm

**social**
- Team
- Coding
- Planing
- Test
- Iteration
- Abstraction

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**GROUPS WITH DIFFERENT INTERESTS**

- **Type 1** experienced with interests in informatics: 
  - 18% (25% m; 5% w)
- **Type 2** novices with interests in usage and applications 
  - 18% (16% m; 23% w)
- **Type 3** job-oriented interests 
  - 18% (23% m; 11% w)
- **Type 4** unable to specify particular motive / no specific motives 
  - 12% (8% m 19% w)
- **Type 5** Informatics just to fill a gap 
- **Type 6** Computer users with few interests related to informatics 
  - 1%

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**MODEL / CODING SCHEME OF SOFTWARE (DEVELOPMENT)**

**product**
- Formal
- Parts
- GUI
- Datastructure
- Algorithm

**process**
- Team
- Coding
- Planing
- Test
- Steps
- Iteration
- Abstraction

**customer**
- Gather Needs
- Analyse Needs
- Cost Estimation
- Cooperation

**evolution**
- Reengineering
- Versions
- Antizipate HCI / Workflow

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**INTERESTS AND EXPECTATIONS ARE GENDER SPECIFIC**

**Computer usage**
- Questions of social impact
- Computer skills are generally important without being able to go into details

**programming and software-development**
- Experienced with computers
- Higher self-confidence in computer usage

**Differences in process-scale:**
- "Teamwork," "Testing" and "Steps," girls have significantly lower values

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MUTUAL INFLUENCES BETWEEN INTERESTS, EXPECTATIONS AND PRECONCEPTIONS

- Experienced with interests in informatics
  - Expecting 'Programming Languages and Software Development'
  - Better computer knowledge (significant correlation with FIM)
  - Regarding process-aspects of software development
  - Positive correlation to software-development: process-scale (0.28)

- Novices with interests in usage and applications
  - Expecting 'Introduction, Usage- and Impact-Courses'.
  - Lesser computer knowledge
  - Disregarding process-aspects of software development
  - Negative correlation to software-development: process-scale (-0.22)
  - But: open for other aspects???

CORRELATIONS WITH PROCESS SCALE

Whole group

With previous computer literacy course at lower secondary level

INFLUENCE OF COMPUTER LITERACY COURSES ATTENDED AT JUNIOR HIGH SCHOOL LEVEL

CONCLUSIONS I: TEACHING METHODS

- Process-aspects of software development

- Similarities to teaching writing:
  - Novices are given a topic to write about:
    - Immediately produce text by writing their first idea, then their next idea, ...
    - In contrast, experts: also planning and revising
    - Naive beliefs about the nature of expert writing: thinking that writing is a smooth and easy process for "good" writers. -> discouraging
  - Possible teaching strategy:
    - Providing students with a model of (writing) programming that involves planning and revising
    - Teaching control strategies

CONCLUSIONS: SUBJECT MATTER

- Programming Languages, Software Development
- Usage and Applications and social impacts

- Product as well as Process aspects of Software Development methods: beginners courses differentiated by subject matters?

- Teaching programming affects understanding of process aspects
  - Developer-user interaction and evolutionary aspects should be integrated: socio-technical view.
  - There is prior knowledge, teaching concepts can rely on
  - Include multiple perspectives (customer etc.)
  - Include socio-technical characteristics of the product software