The work-reflection-learning cycle in software engineering student projects: Use of collaboration tools

PhD defense presentation 21 June 2010, NTNU
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Project based learning

Learning from experience

Reflection

Tools

State-of-the-art lightweight collaboration tools
Contents of the presentation

- Fields of related work
- Structure of the thesis contributions
- Research questions
- Case
- Research approach
- Results
- Contributions
- Limitations
- Further work
Fields of related work

• Software Engineering (SE)
  – Challenges in SE work
  – Project retrospectives

• Computer-Supported Cooperative Work (CSCW)
  – Lightweight tools
  – Use of data collected from the work process

• Learning
  – Computer supported collaborative learning (CSCL) & Technology enhanced learning (TEL))
  – Project-based learning
  – SE Education: capstone projects
  – Theory on individual and organizational learning
How can work and reflection be supported and bridged in software engineering student projects, taking into account the use of lightweight collaboration tools?

**AS-IS**

- **RQ1**: What characterises software engineering student projects?
- **RQ2**: What is the current usage of lightweight collaboration tools to support work in software engineering student projects?

**TO-BE**

- **RQ3**: How can retrospective reflection be supported in software engineering student projects?
- **RQ4**: How can collaboration tools that are used in daily project work be utilized as tools for project based learning?
Case

• Capstone projects (Bachelor IT)
• 3-5 students, one grade
• One semester, 50% of work time
• Software developed for external customer
• Project report
• Work is partially collocated
• Methodology/tools: chosen by the teams
Research approach

• Case studies; data collection 2006-2008

• Interpretive research
  – Data triangulation: Observation, interviews, project artifacts, logs from collaboration tools
  – Two field studies in which single teams were followed throughout their projects
  – Insider research

• Design research
  – Improving the educational practice by trying out solutions and systematically reengineering the learning environment
    – Main object of design: organization of reflection workshops
  – Participation
  – Contributing to theory
Field studies of current practice in SE student teams

Intervention to practice in SE student teams: Supporting retrospective reflection

Model of reflection on (project) work practice

Emerging issues

Cross-community collaboration
Lightweight tools in everyday work
Timeline and curve representations
Individual and collaborative reflection
Bridging work process and learning from that process

Main research steps

Informing theory

Communities of practice
CSCW concepts (coordination, awareness, ..)
SE industry practice for retrospective reflection
Trajectory as a way of making sense of activity/process
The reflective process as return to experience
Distributed cognition

Timeline and curve representations

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Theoretical background: understanding the reflective process

Experience(s) → Reflective process → Outcomes

Experience(s):
- Behaviour
- Ideas
- Feelings

Reflective process:
- Returning to experience
- Attending to feelings
- Re-evaluating experience

Outcomes:
- New perspectives on experience
- Change in behaviour
- Readiness for application
- Commitment to action

(Boud, Keogh et al. 1985)
Results
Cross-community collaboration in SE student projects

• **P1:** Promoting consciousness of stakeholder objectives

• Use of collaboration tools for within-team and cross-community work
  - **P2:** Participation in Open Source Software Development: the role of the broker
  - **P3:** Instant messaging: do’s and don’t’s
# Sluttrapport

## Ansvarsfordelings bugs

- Fikse feil i kombinasjon når man velger en kart i lista som ikke eksisterer lengre.
- "Omr"-panelen må bli en del av applikasjonen.
- Legg "Hjelp"-linken på tjenersiden.
- Zoom og forvirrende knappe som har en timer slik at det er mulig å skifte level flere ganger uten å kontakte tjenner.
- Bug i imageslide ved filtering. Bilder blir farte...

### Dan
- Mulig å trykke på bilder nummeret på kartet.
- Vise radius som bildene ligger innenfor.
- Periode skal filtere fra 1300 frem til i dag. Tår.
- Import må støtte omregninger i database.
- Import må gjøres om slik at den logger til en fil, og kjøres som en daimon som våkner hvert 15 minitt.

### Ikke prioriteret

- Fikse bug med at polygonet ikke alltid fjernes ved trykk av clear, og bytt zoom.

### Gerhard

- Bytte til: Vise bilder N til N+4 i området?
- Vise ved i området"-viser-felt (ikke prioritert)
- Fikse bug med at hele polygonen ikke alltid vises.
- Tovers-funksjonen viser felt-positions
- Snavler med tastatur (ikke prioritert)

### Ellis

- Tegnet:
- Mer informasjon når kart blir lagt til (Progressbar?) (ikke viktig)

### Howard B

- Heije med kart med tanke på flere brukere om gangen, trykk som om du viss-data nOdb og trykker vilkårlig.
- Teste grønseverdier o.l.
P6: Supporting retrospective reflection on a project in a facilitated workshop
Introducing historical data in collaboration tools as an aid to reconstruction of the project process.
P7: A model of reflection on collaborative work
Contributions
**Contribution 1:** an increased understanding of cross-community collaboration in SE student teams

For practitioners and researchers within SE Education:
Rationale and guidelines for developing project courses in the direction of more consciousness, insight and reflection among students and course staff about stakeholder objectives and tool use in cross-community collaboration.
Contribution 2: An increased understanding of the use of lightweight collaboration tools in the work practice of SE student teams

For SE education and PBL:
Knowledge about the typical use of lightweight collaboration tools in the projects can aid understanding of the challenges of specific projects and project courses. Recommendations for the usage of such tools can aid course staff in course organization/team supervision.

For SE practice (small-scale projects):
Knowledge about use/potential of project wikis

For TEL:
Knowledge on current use of collaboration technology (e.g. wikis) used as *work tools* in an educational setting
Contribution 3: New knowledge about how retrospective reflection, as part of a collaborative work practice, can be supported in SE student projects and project work more generally

For course staff in SE projects:
   Guidelines for conducting retrospective workshops

For organizers of PBL: Insight about how reflective workshops can be integrated into the project work practice, and that there is a potential to utilize historical data in collaboration tools to support reflection

For CSCW: More knowledge about how data gathered from a collaborative work process may be used to support that process

For tool designers: Insights about the potential to support the gathering and (re-)use of data for reflection in the development of new collaboration tools or as new functionality in existing tools
**Contribution 4: The model of work and reflection**

For the TEL and CSCW research fields:

Providing a theoretically and empirically grounded model that can be used to analyse and design for collaborative work practices with the aim of supporting participants’ reflection on the practice, possibly with the aid of historical data in collaboration tools.
Answering the research questions

**RQ1:** What characterises software engineering student projects?

**RQ2:** What is the current usage of lightweight collaboration tools to support work in software engineering student projects?

**RQ3:** How can retrospective reflection be supported in software engineering student projects?

**RQ4:** How can collaboration tools that are used in daily project work be utilized as tools for project based learning?
Summary

The thesis brings forward state-of-the art knowledge of work and learning in SE student teams with respect to cross-community collaboration, the use of lightweight collaboration tools, and techniques for supporting retrospective reflection.

The thesis contributes new insights on how individual and collaborative reflection, possibly aided by historical data in collaboration tools, can bridge work and learning from that work.
Limitations

• Research approach
  – Wiki walkthrough tool only tested in scenarios
  – Study of use of historical data in Trac to support reflection: only one team
  – Assumption about project students’ current attitudes towards reflection is true for some project courses

• Theory
  – Use of a single theoretical framework throughout the project might have lead to a stronger theoretical grounding of empirical insights
Further work

• **SE project course development**
  • Increase students’ consciousness of collaboration tool use
  • Refine and improve the timeline and satisfaction curve technique *(research at NTNU spring 2010)*
    – Support for process improvement within each project
    – Reflection workshops as a tool for design research / course improvement
    – Possible use of historical data in collaboration tools
• **Adapt the timeline and satisfaction curve technique to other domains**
• **Develop the reflection model into a framework** to aid the design for reflective learning in the workplace *(EU project)*
  • Guide the selection of appropriate tools and reflection techniques based on the type of work setting
  • Include the organizational level
Extra slides
<table>
<thead>
<tr>
<th>Theorist</th>
<th>Activity and learning is about..</th>
</tr>
</thead>
<tbody>
<tr>
<td>J. Dewey</td>
<td>Experimentation</td>
</tr>
<tr>
<td>J. Piaget</td>
<td>Adaptation (assimilation + accomodation)</td>
</tr>
<tr>
<td>J. Bruner</td>
<td>Cognitive structure (schema, mental models) providing meaning and organization to experiences. (Later work: focus on the social/cultural)</td>
</tr>
<tr>
<td>A. Bandura</td>
<td>Social learning, observational learning</td>
</tr>
<tr>
<td>G.H. Mead, H. Blumer</td>
<td>Symbolic interactionism; behaving according to the meanings that things and events have aquired through the individual’s interaction with others. Meanings emerging through interpretation.</td>
</tr>
<tr>
<td>L. Vygotsky</td>
<td>Expanding the repertoire of actions within a zone of proximate development. Tool mediation.</td>
</tr>
<tr>
<td>A.N. Leont’ev, Y. Engeström</td>
<td>Expanding the repertoire within the context of socio-historical activity</td>
</tr>
<tr>
<td>J. Lave, E. Wenger</td>
<td>Situated learning; participation (-&gt; meaning, identity) in a community of practice</td>
</tr>
<tr>
<td>Hutchins, Salomon</td>
<td>Distributed cognition; the social aspects of cognition. Knowledge developing as a system of thinking agents interact with artifacts, transforming representations</td>
</tr>
</tbody>
</table>
Theoretical background: Constructivism

- Our thinking and action is mediated by social context. This context provides the tools (e.g. artifacts, language) for making sense of / constructing reality
  - Tensions trigger action and change (individual and/or social)
  - Focus on the cognitive vs. the social differing among theorists

- Social constructionism: Knowledge as socially constructed
  - Kuhn; Berger and Luckman
- Papert’s constructionism (theory of learning based on Piaget)
- Collaborative knowledge construction (an important topic of CSCL)

- Constructionism vs. Constructivism:
  - Two sides of the same coin; different research fields
  - The terms not used consistently in the literature

- This thesis: Main focus on constructivism
  - Although the term ‘constructionism’ was used in the thesis introduction
Design research (I)

FIGURE 1  The complex features of design experiments.

(A. Brown 1992)
Design research (II)

Intended function → Intended behaviour → Form → Actual behaviour → Actual function

Theoretical model

Empirical test

Theory building

(Middleton 2008)
Theoretical background: trajectory as a human way of understanding activity

- Points of action/interaction
- Sub-trajectories
- Past and future

(A. Strauss 1993)
Coss-community collaboration in SE student projects

- Participating in multiple communities (project team, university course, SE profession, ...)
- Collaborating with different stakeholders (supervisor, customer, technology provider, ...)
- Boundaries, brokering and boundary objects