A case study: Tablets in orchestrated, collaborative activities

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Overview

• Developing models for measuring quality of collaboration
• A study on use of tablets in collaborative learning
Models of quality of collaboration activities using a rating scheme

Based on:

# Meier et al. (2007) rating scheme

<table>
<thead>
<tr>
<th></th>
<th>Original setting</th>
<th>New setting</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CSCL tool</strong></td>
<td>Desktop-videoconferencing system with shared text editor</td>
<td>Synergy: shared whiteboard and chat</td>
</tr>
<tr>
<td><strong>Domain</strong></td>
<td>Medical decision making</td>
<td>Computer programming (algorithm building)</td>
</tr>
<tr>
<td><strong>Collaborators</strong></td>
<td>Intermediates; complementary prior knowledge (psychology and medicine)</td>
<td>Beginners; similar prior knowledge</td>
</tr>
</tbody>
</table>
Meier et al. (2007) rating scheme dimensions

<table>
<thead>
<tr>
<th>Category</th>
<th>Dimension 1</th>
<th>Dimension 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication</td>
<td>Sustaining mutual understanding</td>
<td>Dialog management</td>
</tr>
<tr>
<td>Information Processing</td>
<td>Information pooling</td>
<td>Reaching consensus</td>
</tr>
<tr>
<td>Coordination</td>
<td>Task division</td>
<td>Time management</td>
</tr>
<tr>
<td></td>
<td>Technical coordination</td>
<td></td>
</tr>
<tr>
<td>Relationship Management</td>
<td>Reciprocal interaction</td>
<td></td>
</tr>
<tr>
<td>Motivation</td>
<td>Individual task orientation</td>
<td></td>
</tr>
</tbody>
</table>
### Kahriranis et al. (2009) adapted collaboration rating scheme

<table>
<thead>
<tr>
<th>Aspect of collaboration</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Communication</td>
<td>1. Collaboration Flow</td>
</tr>
<tr>
<td></td>
<td>2. Sustaining Mutual Understanding</td>
</tr>
<tr>
<td>Joint information</td>
<td>3. Knowledge Exchange</td>
</tr>
<tr>
<td>processing</td>
<td>4. Argumentation</td>
</tr>
<tr>
<td>Coordination</td>
<td>5. Structuring the Problem Solving Process</td>
</tr>
<tr>
<td>Interpersonal Relationship</td>
<td>6. Cooperative Orientation</td>
</tr>
<tr>
<td>Motivation</td>
<td>7. Individual Task Orientation (for dyad mean or absolute difference)</td>
</tr>
</tbody>
</table>
Development of a Collaboration Quality Estimation Model

Data set used
• 350 students of 1st year working in dyads to solve an algorithmic problem using Synergo (academic year 2007-2008) duration of activity 45’ to 75’
• 260 collaborative sessions
• Grading according to the quality of solution and quality of collaboration
36 derived metrics used
(Kahrimanis et al. 2010)

<table>
<thead>
<tr>
<th>Event type</th>
<th>Metric type</th>
<th>Additional Metrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chat messages</td>
<td>number of [ ]</td>
<td>average number of words per message (AWM)</td>
</tr>
<tr>
<td>Main actions in the Workspace</td>
<td>rate of [ ]</td>
<td>number of question marks (NQM)</td>
</tr>
<tr>
<td>Overall actions in the Workspace</td>
<td>symmetry of [ ]</td>
<td>symmetry of text changes (STC)</td>
</tr>
<tr>
<td>Overall events</td>
<td>alternations of [ ]</td>
<td>number of objects alternated more than X times (NOA_X)</td>
</tr>
</tbody>
</table>

Metrics that cannot be described by the typology on the left

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Quality of Collaboration Estimator
(Kahrmanis et al. 2010)
Partial Least Squares Regression Model

collaboration_quality_avg =
0.460 + 0.004*C4 - 0.005*C6 + 0.011*C8_17.5 - 0.012*C7 +
0.602*EV3 + 0.447*STC - 0.001*MW1 + 0.008*MW6

<table>
<thead>
<tr>
<th>Measure</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q²</td>
<td>0.354</td>
</tr>
<tr>
<td>R²Y</td>
<td>0.369</td>
</tr>
<tr>
<td>R²X</td>
<td>0.343</td>
</tr>
</tbody>
</table>

Stone & Geisser Coefficient
(cross validation)

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Use of Quality of Collaboration Estimator as discriminator between cases of good and bad collaboration

- The model scored between 76.6% to 79.2%, with the exception of one dimension of lower quality.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7a</th>
<th>7b</th>
<th>average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>76.6%</td>
<td>74.7%</td>
<td>79.2%</td>
<td>78.6%</td>
<td>69.2%</td>
<td>76.2%</td>
<td>78.0%</td>
<td>77.4%</td>
<td>78.1%</td>
</tr>
</tbody>
</table>
Use of Quality of Collaboration Estimator as automatic rater

- The model had acceptable performance as rater as the inter-rater reliability with human raters had the following values: $\text{ICC} = .54$, Cronbach’s $\alpha = .70$, Spearman’s $\rho = .62$ acceptable for $\alpha$ και $\rho$ (George, & Mallery, 2003; Garson, 2009), not for $\text{ICC} (.7)$ (Wirtz & Caspar, 2002). This applies both for the average collaboration quality value and the individual dimensions.
#2 The tablets study

- Study face-to-face collaborative activities mediated by desktop and tablet computers
- Determine whether tablet computers and their key features, such as free handwriting and drawing, no keyboard, affect computer-mediated collaboration
- Study the differences in collaborative practices that stem from the use of different medium
Experimental Setup(1)

3Ts

Explicitly defined task: The construction of a keystroke level model (KLM)

Dyads, not changing through the study, for teams

Time pre-defined for all stages of the activity – teacher has the opportunity to re-define the time schedule

Tablets for all

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Task (2-phase group activity)

• fill a form using various text input devices
• Measure the time taken
• Discuss the findings

• Estimate this time using Keystroke Level Model
• Discuss the model

(do the above using both a desktop and a tablet)
Text input devices used

Soft keyboard on a tablet

Numeric keyboard on a desktop
Experimental Setup (2)

- 10 participants: students of Human-Computer Interaction (HCI) grouped in 5 dyads
- Task: construction of keystroke level models (KLM) for data entry in a form while using two types of keyboard (software and numeric)
- 2 cases: Case A – Construction of the KLM for numeric keyboard using Desktop Computer
  Case B – Construction of the KLM for software keyboard using Tablet Computer
- Within-Subjects design in two phases:

<table>
<thead>
<tr>
<th>Phase A</th>
<th>Phase B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case A: dyadB, dyadE</td>
<td>CaseA: dyadA, dyadC, dyadD</td>
</tr>
<tr>
<td>CaseB: dyadA, dyadC, dyadD</td>
<td>Case B: dyadB, dyadE</td>
</tr>
</tbody>
</table>

- The collaborative sessions were supported by the groupware application **Synergo v5** and the activity was monitored and orchestrated by the instructor’s interface (Synergo Supervisor Station v5)
Synergo v5

**Synergo Client**
- Groupware Application for the design of diagrammatic representations
- Provides a shared workspace and a chat facility to support communication
- Libraries of various objects for ERDs, Concept Maps and Flowcharts
- Component that support free hand writing and sketching

**Synergo Analysis tools**
- Reproduces the recorded collaborative sessions from logfiles
- Provides Statistics for the activity of a session
- Provides Automatic Metrics produced by the logfiles of the saved session

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Metrics & Criteria for Analysis

In the present study the analysis of collaborative sessions is based on:

• Qualitative analysis of the recorded sessions

• Activity statistics

• Automatic metrics of collaboration extracted from sessions’ logfiles
Qualitative analysis of recorded sessions

- No participant used the stylus as a drawing tool, only as a pointing device
- The lack of mouse lead students to use the keyboard for basic actions
- Students were cautious regarding the use of the tablets
- many participants used the tablets as desktop computers, although they had the opportunity to hide the keyboard
Activity statistics (1)

• Activity statistics refer to the volume and type of workspace activity of each user
• Produced by the logfiles of the groupware application
• Used to provide an overview of collaborative sessions and the activity distribution between partners
Automatic metrics of collaboration quality(1)

- Automatic metrics are proved to be indicators of the collaboration quality since they correlate with several aspects of collaboration
- Intense workspace activity is a bad indicator of the quality of collaboration
- Efficient collaboration is indicated by balanced activity in the workspace [5]

Automatic metrics of collaboration quality(2)

In present study the automatic metrics used, are:

• **Number of main actions in the workspace – MW1**: the number of actions in the workspace as “create object”, “delete object”, “modify object”, “paste object”, and “insert object relationship”.

• **Rate of main actions in the workspace – MW2**: the sum of main actions in the workspace per duration of the collaborative process.

• **Symmetry of main actions in the workspace – MW3**: the distribution of main actions in the workspace among the participants.

• **Number of Overall Actions in the workspace – OW1**: all the actions in the workspace including all main actions in the workspace plus “resize object”, “move object”, “set object to front”.

• **Rate of Overall actions in the workspace – OW2**: the sum of overall actions in the workspace per duration of the collaborative process.

• **Symmetry of Overall actions in the workspace – OW3**: the distribution of overall actions in the workspace among the participants.

• **Symmetry of text changes – STC**: actions in the workspace that change of the textual content of an object.

> Metrics **MW1, MW2, OW1** and **OW2** reveal over-intense workspace activity

> Metrics **MW3, OW3** and **STC** indicate balanced workspace activity between partners
Automatic metrics of collaboration quality (3)

- Almost all of the metrics indicate excessive activity for the sessions supported by tablets.
- Overall workspace activity and its rate are more intense when tablets where used (OW1_desk < OW1_tab && OW2_desk < OW2_tab)
- More intense activity for tablets regarding main actions (MW1_desk < MW1_tab) but similar rates (MW2 metric).

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Automatic metrics of collaboration quality(4)

• Metrics that reveal **balanced collaboration (OW3 and MW3)** scored higher for sessions supported by desktop computers: OW3_desk > OW3_tab & MW3_desk > MW3_tab

• That was not the case for **Symmetry of text changes (STC)** metric (STC_tab>STC_desk) for which however the standard deviation was large (STC_desk averaged 0.48 (s=044))
Discussion (1)

- dyads managed to complete the given task in time
- the participants were reluctant to use the features of the tablet computers and often used the tablets as regular desktop computers
- the key feature of the tablet, the stylus, was not taken advantage of. It was used as a pointing device although the groupware application allowed the use of stylus as drawing tool
- pointing devices such as the mouse are so strongly attached to everyday practice and interaction with computers that even when missing, users try to substitute them
Discussion (2)

- From CaseA to CaseB there was a re-distribution of workspace activity and even in some cases a role switch regarding activity.

- In some cases overwhelmed participants withdrew when in front of a tablet computer. This event caused their partners to take over.

- As revealed by automatic metrics of collaboration, the collaborative sessions mediated by tablets were characterized by excessive workspace activity that is an indicator of bad collaboration quality and lack of balanced collaboration compared to sessions mediated by desktop computers.
Discussion (3)

• The lack of prior experience and interaction with tablets was an obstacle towards successful collaboration.

• Even though the tablet, is a flexible tool that resembles the traditional students' tools such as notepads and pencils, students used it as a desktop computer to which they were more familiar with.

• The adaptation of new technologies and tools into everyday activities is a delicate and time consuming process that can lead to opposite results than expected.
thank you