FernUniversität in Hagen

Enterprise Modelling Research Group

Shaping the digital transformation: Mixed methods research based on multi-modal observations of individual modeling processes

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Overview

» Conceptual modeling essential expertise for understanding and shaping the digital transformation

» As a task, conceptual modeling involves several complex cognitive processes:

» abstracting, conceptualizing, associating & contextualizing, interpreting & sense-making, judging & evaluating, thinking ahead & anticipating & envisioning, drawing & visualizing

» Surprisingly little known about conceptual modeling processes, modeling difficulties and need for (tailored) modeling support

» Systematic investigation of individual modeling processes via observing modelers during model construction using a modeling tool

Research objectives

Primary research objective:

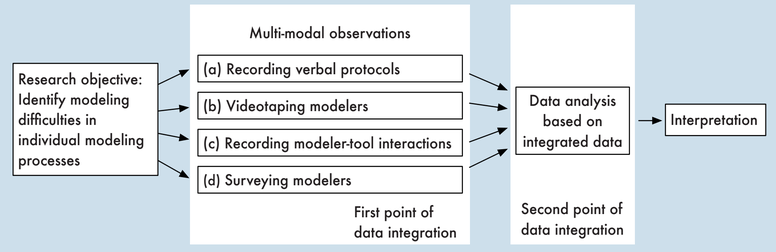
» Achieve a richer and more complete understanding of modeling processes, modeling difficulties, and need for tailored modeling support

Meta research objectives:

» Develop a taxonomy of modeling difficulties over the course of multiple studies of individual modeling processes

» Contribute to a theoretical foundation informing design science research on developing tailored support for modelers

Mixed methods research design



» Integrating complementary modes of observation and including two points of data integration

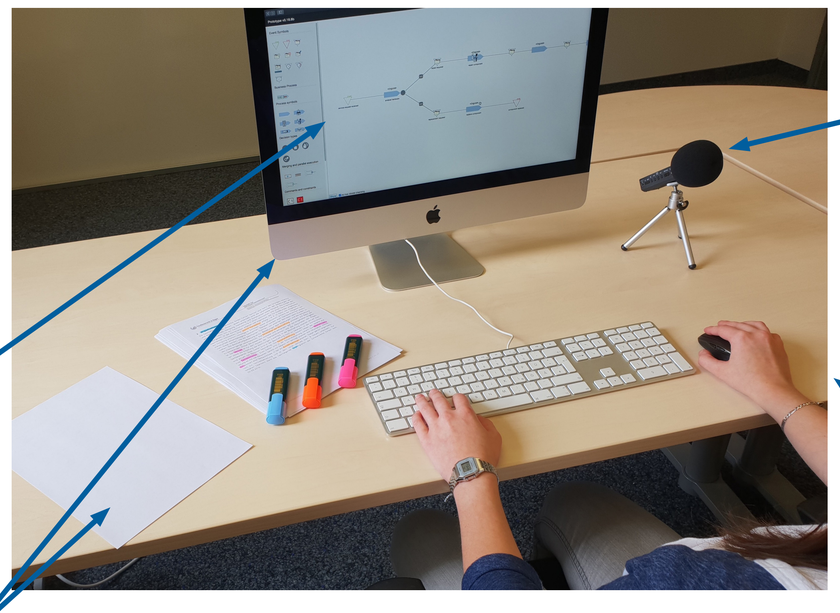
» **Foundational assumption**: Individual modeling processes demand and deserve study from several complementary perspectives – due to the richness of cognitive processes involved in conceptual modeling and its complexity

Multi-modal observation approach

» Tailored to observing individual modeling processes using a modeling software tool

» Combines four modes of observation

» TOOL, a webbrowser-based modeling tool and observatory implements observation approach



Recording modeler-tool interactions:

» Every interaction during model construction recorded as time-discrete event

» Aimed at observing the modelers' interactions with the graphical model editor

Recording verbal protocols:

» Modelers asked to verbalize all their thoughts during model construction (think aloud)

» Targets the reasoning of modelers and their cognitive processes during conceptual modeling

Videotaping modelers:

» Modelers videotaped from an 'over-the-shoulder' perspective during modeling

» Aimed at capturing the modelers' behavior and overall interaction with the modeling tool during the work on a modeling task

Surveying modelers:

» Surveys comprising closed-ended and open-ended questions pre- & post-modeling

» Aims to gather additional data from modelers (e.g., self-assessment regarding encountered modeling difficulties)

Data analysis

» Integration of data from the complementary modes of observation

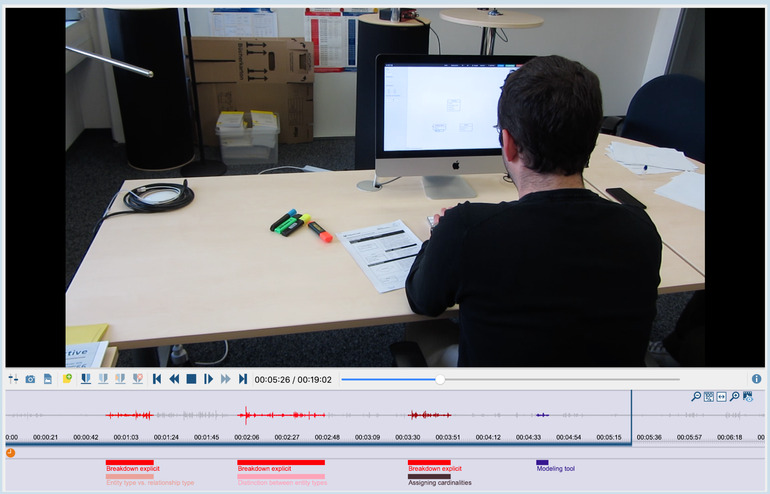
» Identification of modeling difficulties based on the notion of cognitive breakdowns

» Coding of audio-visual protocols (verbal protocol + video) for cognitive breakdowns: systematically assigning video segments to codes with the aim of data condensation

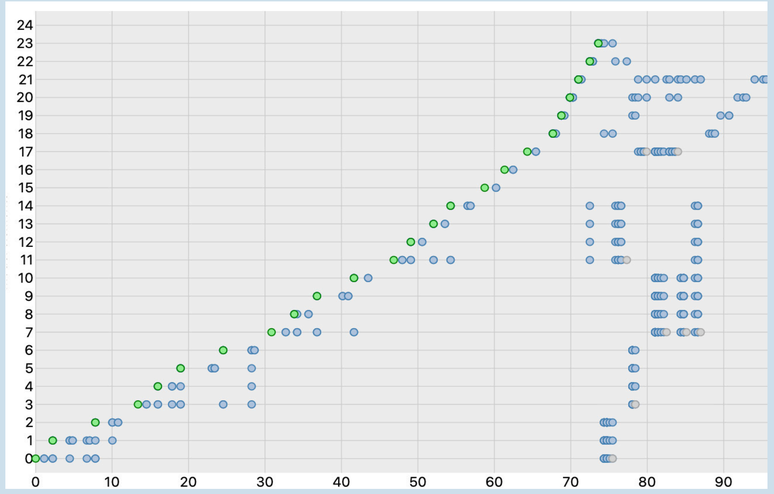
» Analyzing visualizations of modeler-tool interactions to identify anomalous situations and to solve unclear situations

» Reviewing pre- and post-modeling surveys for perceived difficulties as indication for closer inspection (self-disclosure)

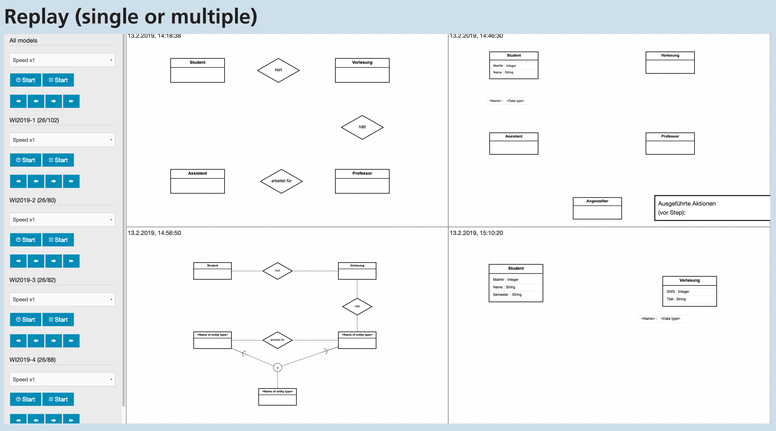
Coding of audio-visual protocols



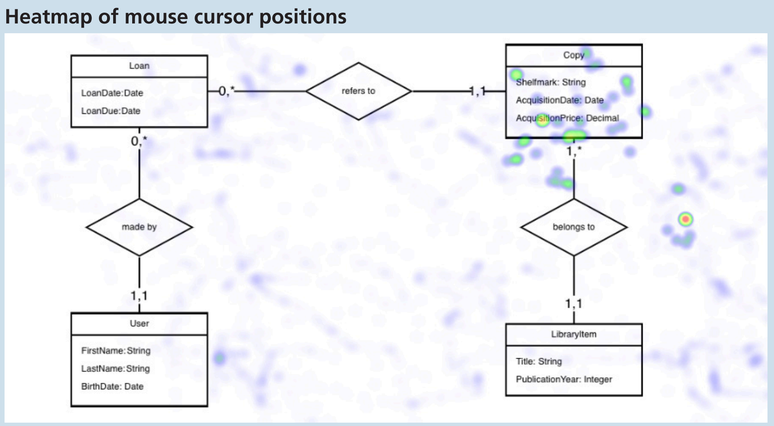
Dot diagram



Replay (single or multiple)



Heatmap of mouse cursor positions



Exploratory results and outlook

» Exploratory studies with non-experienced and experienced modelers constructing a conceptual data model

» Preliminary results: five types of modeling difficulties while performing a data modeling task

» *Only* the integration of complementary observation modes allows to identify a wide range of modeling difficulties

» Exploratory results as starting point for developing a taxonomy of modeling difficulties over the course of multiple studies

» Follow-up studies to refine classification:

» Integrate findings from observing data and process modeling

» Subjects with various backgrounds and levels of modeling knowledge and experience

» Taxonomy as theoretical foundation for design science research on developing (tool) support for modelers that systematically and deliberately targets modeling difficulties

References

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» Rosenthal K, Ternes B, Strecker S (2020) Understanding individual processes of conceptual modeling: A multi-modal observation and data generation approach, in Modellierung 2020, Vienna, Austria, February 19–21, pp. 77–92.

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