

Supplementary Material 2

Task types for graphical modeling

Table 1. Overview of task types investigated in the think-aloud study

Task type	Description	Example
Interpreting model content (MU1/CR)	<p>This type of task tests whether students can understand and thus describe the individual model elements in the given model as well as the statements and the meaning of the model (semantics) and the underlying concepts.</p> <p>A model is given whose model elements have textual identifiers that refer to a specific context. Students are required to either reflect the content-related statements of the model in natural language (free text) or to answer open content-related questions about the model.</p>	<p>Take a look at the following UML class diagram. This models the relationship between telephone companies, customers and the bills they receive.</p> <p>[UML diagram]</p> <p>Based on this diagram, explain in natural language and in a way that is understandable to laypersons (i.e. non-computer scientists) what information a customer finds on their bill and how it is structured.</p>
Interpreting model content (MU1/SR)	<p>In this type of task, a model and several context-related statements about the model content are given. For each statement it must be checked whether it applies to the model. It is therefore a task with an answer-choice procedure, in which a decision must be made for each item as to whether it is correct or incorrect.</p> <p>[Note: Task type was renamed after this study: “Analyze model content – Multiple Choice”]</p>	<p>Take a look at the following UML class diagram. This models the relationship between telephone companies, customers and the bills they receive.</p> <p>[UML diagram]</p> <p>Based on this diagram, assess whether the following five statements are correct or incorrect and mark this with a cross in the corresponding column.</p> <p>[Multiple Choice items]</p>
Error finding (MU3)	<p>This type of task requires a comprehensive, systematic examination of a given model, especially with regard to errors and inconsistencies (e.g., concerning syntax, semantics, and pragmatics), and the explanation of the errors.</p>	<p>Your colleague Julia Stork asks you for help with a project she is currently working on. She asks you to review a UML class diagram in which she is modelling an organizational register. She has provided you with a description of the situation to be modeled and her diagram.</p> <p>[description of the scenario]</p> <p>[UML class diagram]</p> <p>Make a note of any errors you can find in the UML class diagram and explain them briefly.</p>
Model adjusting based on new	<p>In this type of task, learners are asked to modify a given (or previously self-created) model, e.g., to correct content errors or to</p>	<p>In the course of extending an e-assessment system, new functions are to be introduced and additional data</p>

requirements (MB2)	meet new requirements. This may require adding or removing model elements/parts. In this task type, a factual situation is given.	stored. The UML class diagram for the data model of the previous system is shown below. [description of new requirements] Make the necessary changes and additions to the diagram below so that it meets the new requirements. [UML class diagram to be adjusted]
Model building based on a scenario - simple (MB4s)	In this type of task, learners are required to independently create a graphical model from scratch based on a given problem (usually a situation described in natural language). The modeling language to be used is given.	Create a UML class diagram for a software system to manage the event calendar of a sports club. The calendar should make it possible to create events for which a title, a location and a start and end date can be saved. It is also possible to enter whether the event is public or internal to the club. All club members receive an account in the system and can register or deregister for each event. They can enter an optional comment for each registration or deregistration.
Model building based on a scenario - complex (MB4c)	(s. above) The degree of difficulty of this task type varies in particular by the different degree of complexity of the context, i.e. the extent of the model to be created (in the sense of the number of model elements to be created) as well as by the hints given in the task (e.g. hints on model elements to be considered).	