

Software development process model and methodology for virtual laboratories



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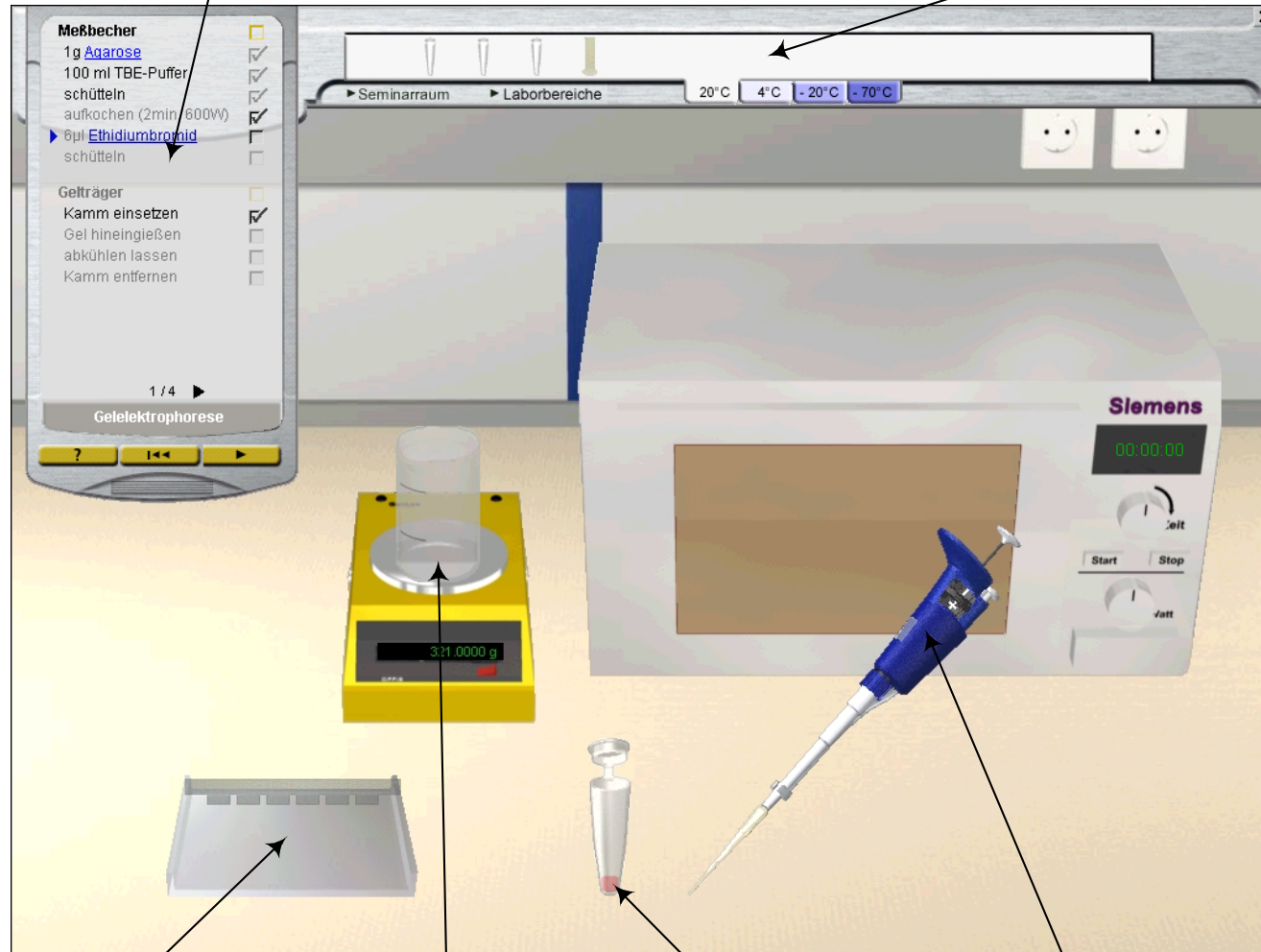
Introduction: What is a virtual laboratory?

- multimedia reproduction of a real laboratory into a computer system which allows explorative learning
 - ⇒ highly interactive virtual reality environment
- learning complex lab procedures
- preparation to a real practical course
- areas of application:
 - schooling,
 - university education,
 - training on-the-job

Introduction: Example of a workspace

instruction-window

transportation-ledge



accessory

receptacle

substance

laboratory device

(taken from *GenLab*, <http://www.offis.de/genlab/>)

Why an own process model for virtual labs?

- experiences gained with *GenLab* have shown, that in particular a suitable **development methodology** for virtual laboratories is needed
- **existing process models** are too abstract to be profitable for the development of virtual laboratories
- **media production** and **didactic concept** are hardly considered by them
- special **multimedia process models** are not suitable for practice

The requirements to the process model:

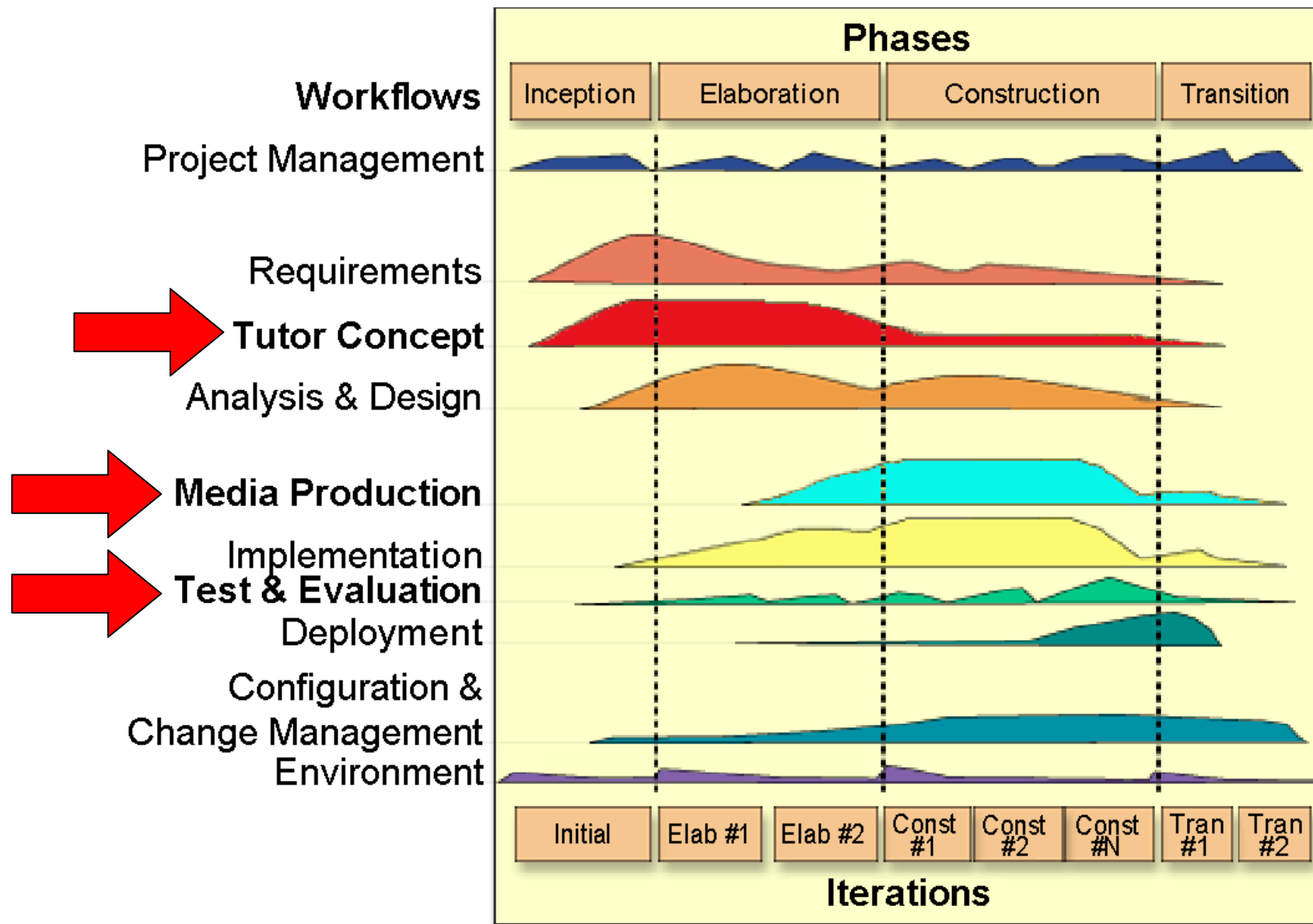
- **multimedia aspects:**
 - design of the graphical user interface
 - consideration of the media production
- **didactic aspects**
- **organizational aspects:**
 - heterogeneity of the developer team
 - involvement of the ordering customer and the final users
- **software engineering aspects:**
 - facility for adaptation of the process model
 - reusability of devices, receptacles and substances
 - suitability of tests and risk analyses

Evaluation of existing process models:

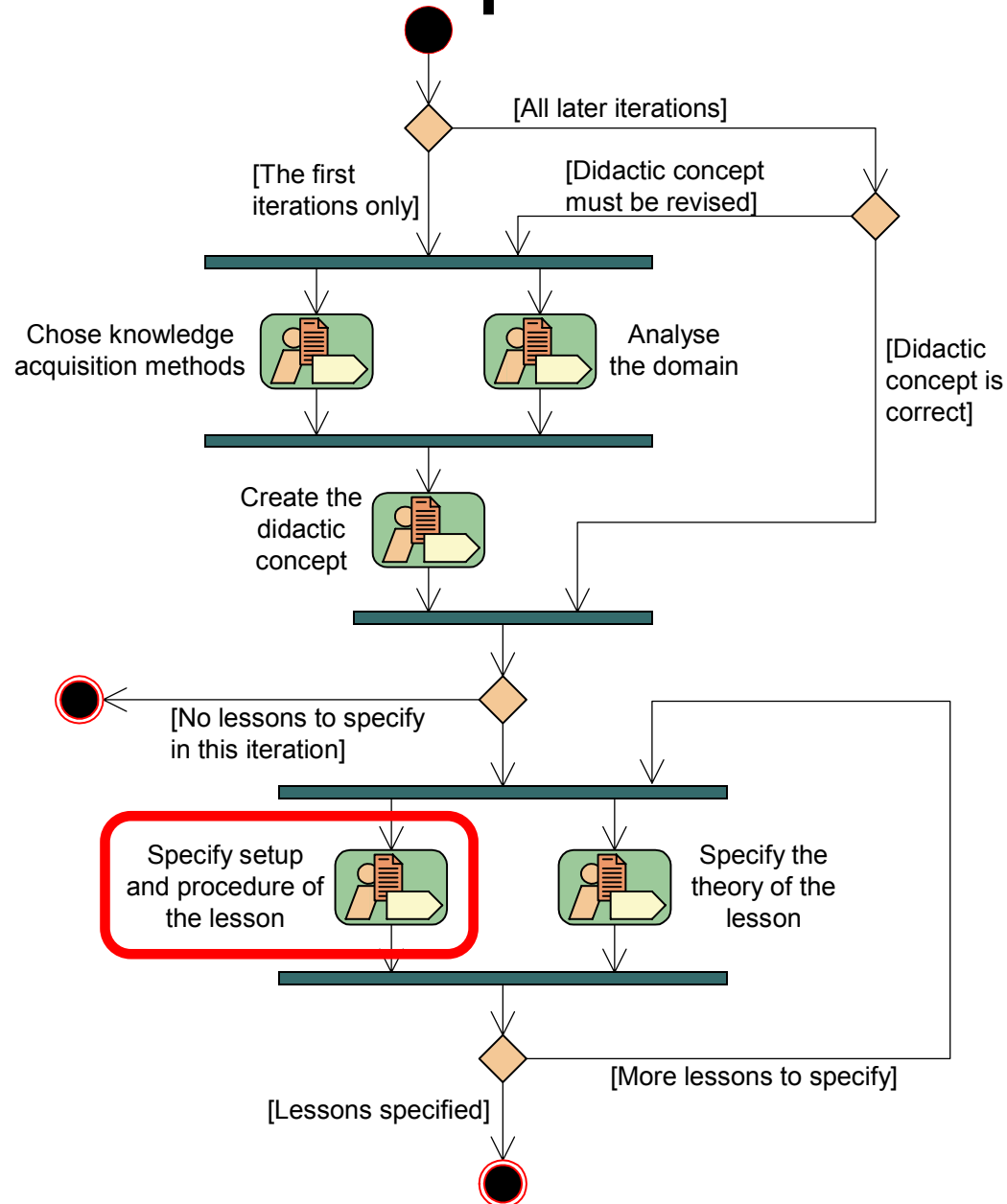
- **classical process models**, e.g.: (iterative) phase model, prototype model, evolutionary software development, spiral model, V–Modell, object-oriented software development and Catalysis.
- **special process models** for multimedia systems and multimedia CBT systems.
- **modern process models**: Unified Software Development Process (USDP), **Rational Unified Process (RUP)**, Object Engineering Process (OEP), eXtreme Programming (XP).

⇒ develop a new process model or adapting an existing one?

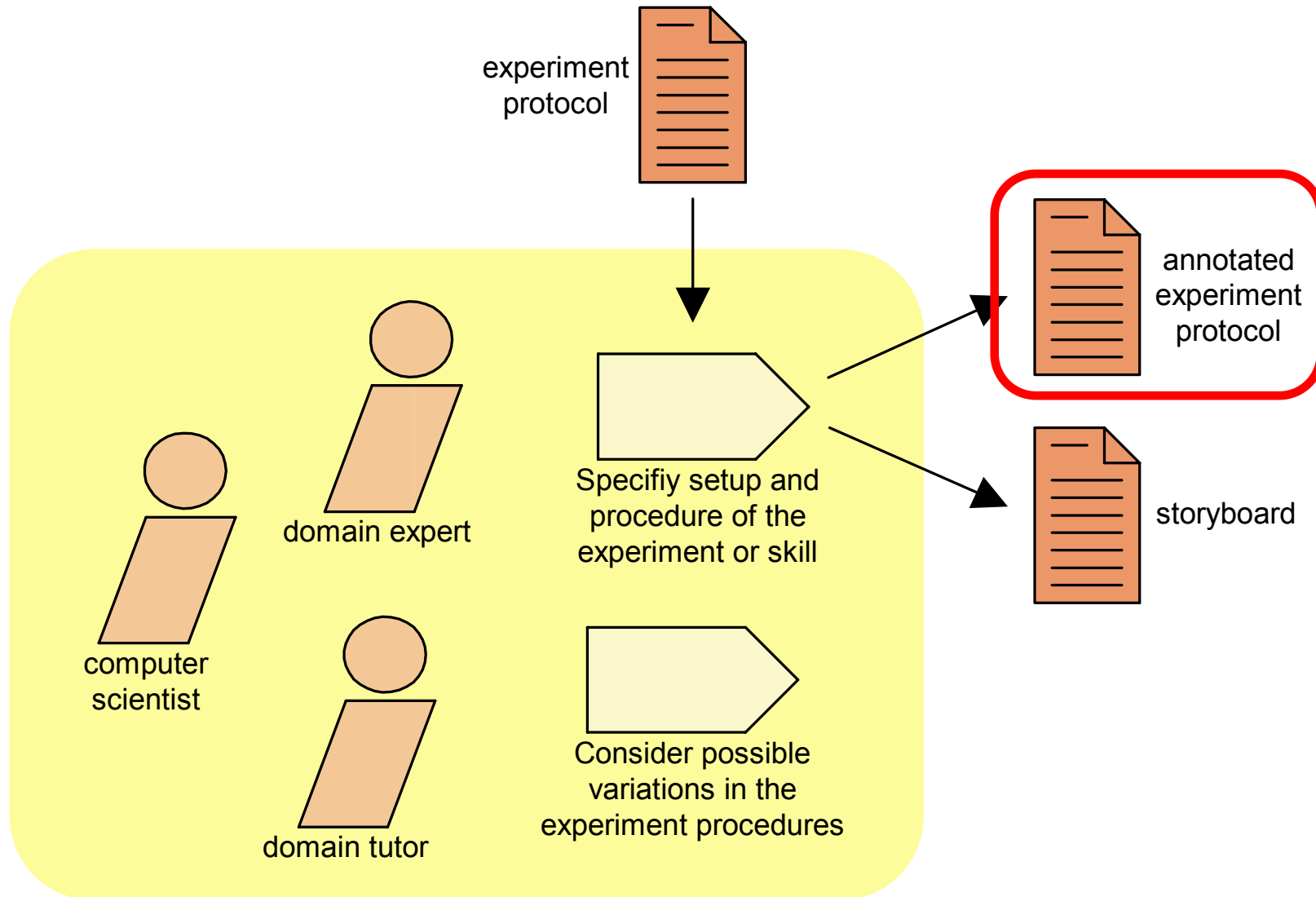
Solution: the *VirtLab*-Process



Workflow: Tutor Concept



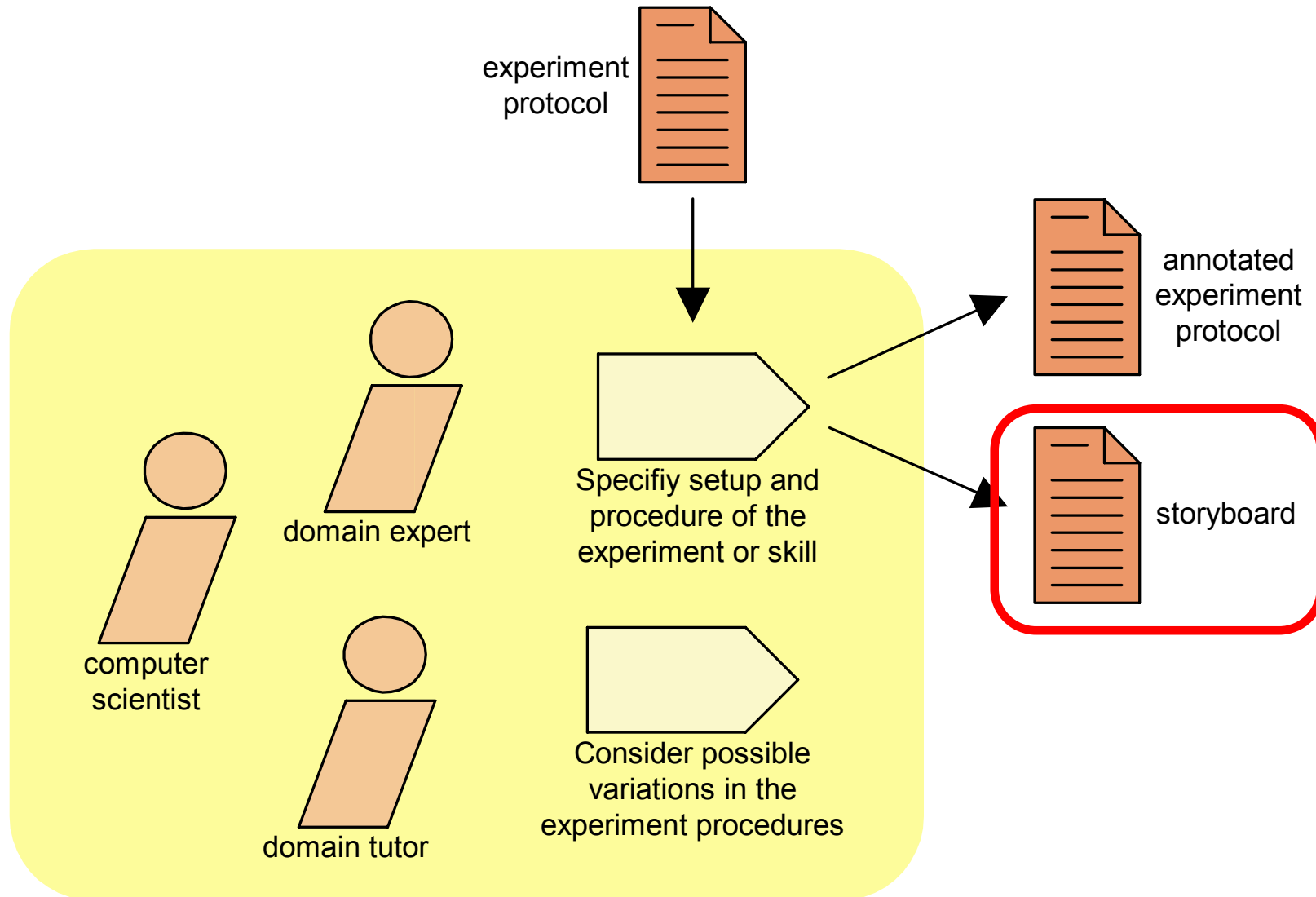
Workflow Detail: Specify setup and procedure of the lesson



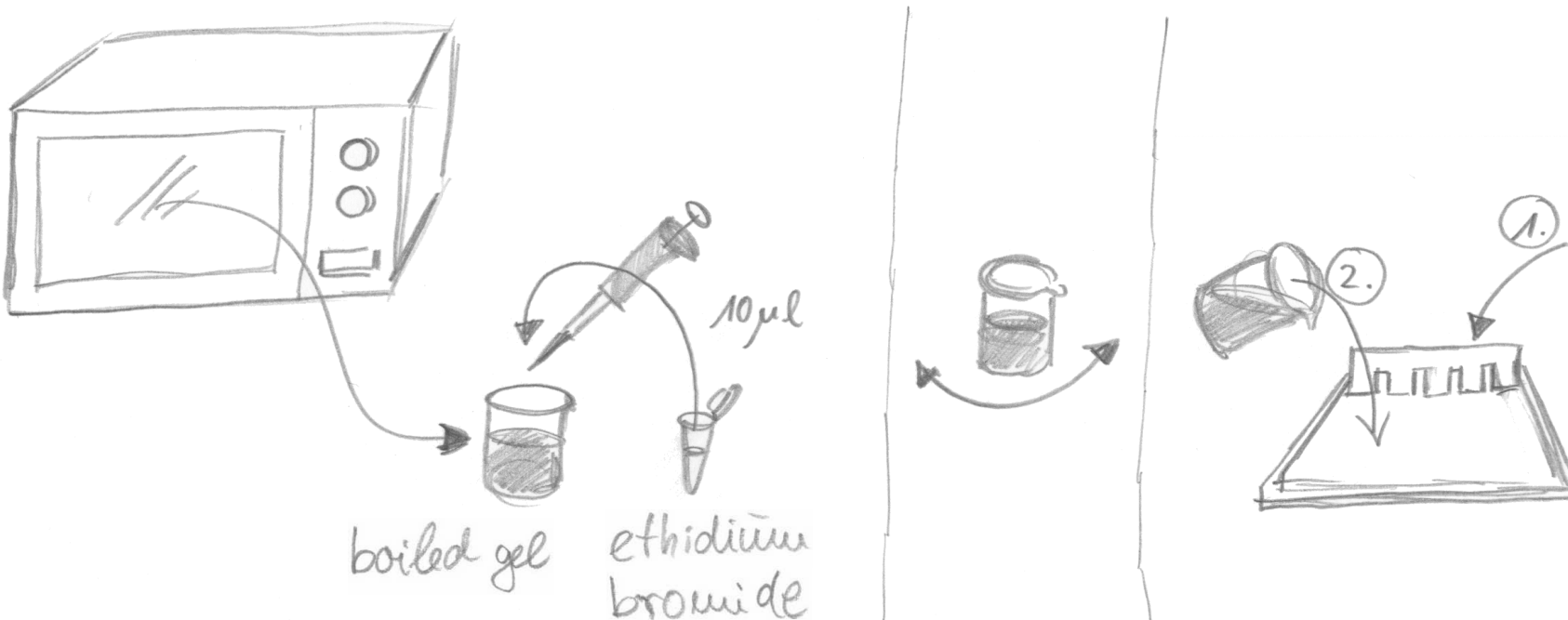
Artifact: annotated (experiment) protocol

- **experiment protocol**: sequential description of the work-steps that are to conduct in an experiment
- **important information is missing** in these protocols:
 - which laboratory devices and receptacles are taken and how they are used
 - storage and safety regulations of the substances
 - ...
- consider the problems of **virtualisation**:
 - proportions of the laboratory equipment
 - number of reaction tubes
 - ...
- additional **activity** and **statechart diagrams** are build

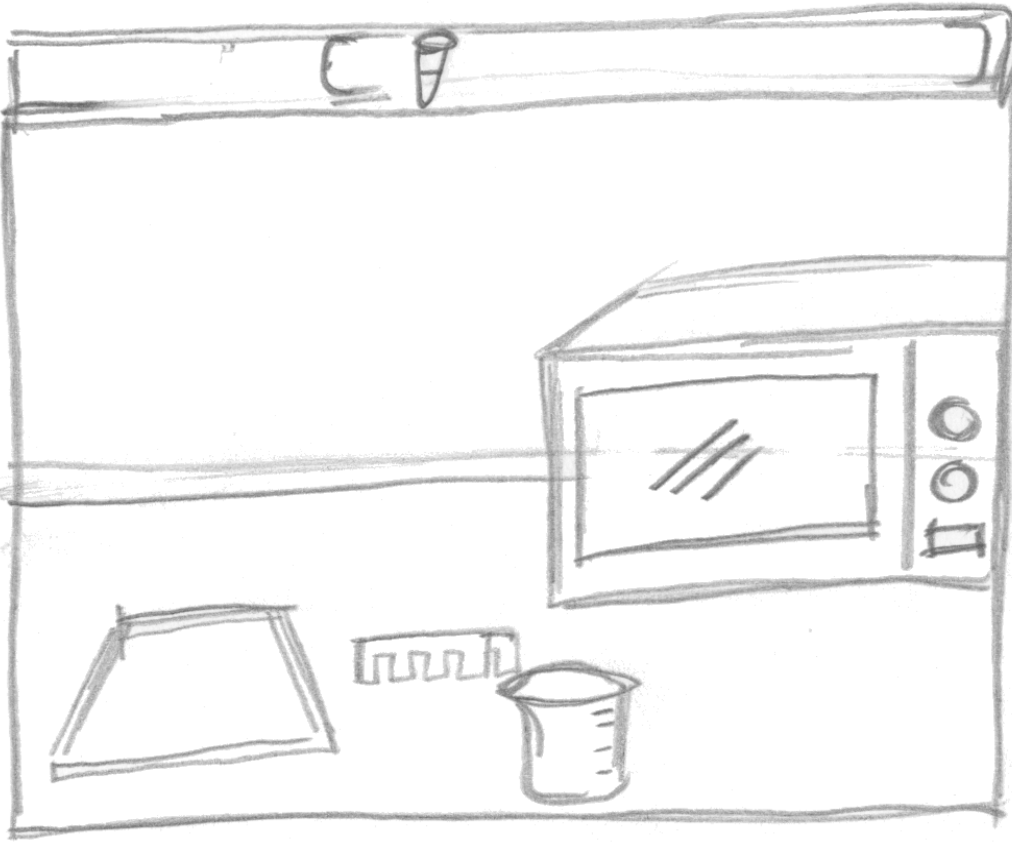
Workflow Detail: Specify setup and procedure of the lesson



Artifact: Storyboard for experiment procedure

<p>Application: <i>GenLab</i></p>	<p>Learning unit: <i>gel electrophoresis</i></p>	<p>Page number: 3 Originator: <i>Chris Red</i> Coordinator: <i>John Blue</i> Date: <i>7 December 2001</i></p>
<p>Sketch of the lab procedure:</p> 		

Artifact: Storyboard for experiment setup

<p>Application: <i>GenLab</i></p>	<p>Learning unit: <i>gel electrophoresis</i></p>	<p>Page number: <i>1</i> Originator: <i>Chris Red</i> Coordinator: <i>John Blue</i> Date: <i>7 December 2001</i></p>
<p>Sketch of the setup:</p> 		<p>Workspace: <i>Microwave</i></p> <p>Applied experiment components:</p> <ul style="list-style-type: none">- <i>gel tray</i>- <i>gel comb</i>- <i>beaker</i>- <i>ethidium bromide (in transportation-ledge)</i>

Conclusion

- **systematic approach** of a process model and methodology for virtual laboratories
- adaptation of the RUP necessitated only insignificant changes to the workflows \Rightarrow **high recognition effect** and with it **high acceptance**
- **CASE-tools** to **support** the development methodology:
 - create laboratory devices, receptacles and substances
 - specify setup and procedure of the experiments
 - draw the storyboard
 - ...
- identify further **application-classes**, for which it is worthwhile to develop an specialized process model, too