UNIVERSITY OF GOTHENBURG

Navigating Knowledge Waters:
A Systematic Approach to Scenario Design for Simulator-Based Training

Introduction

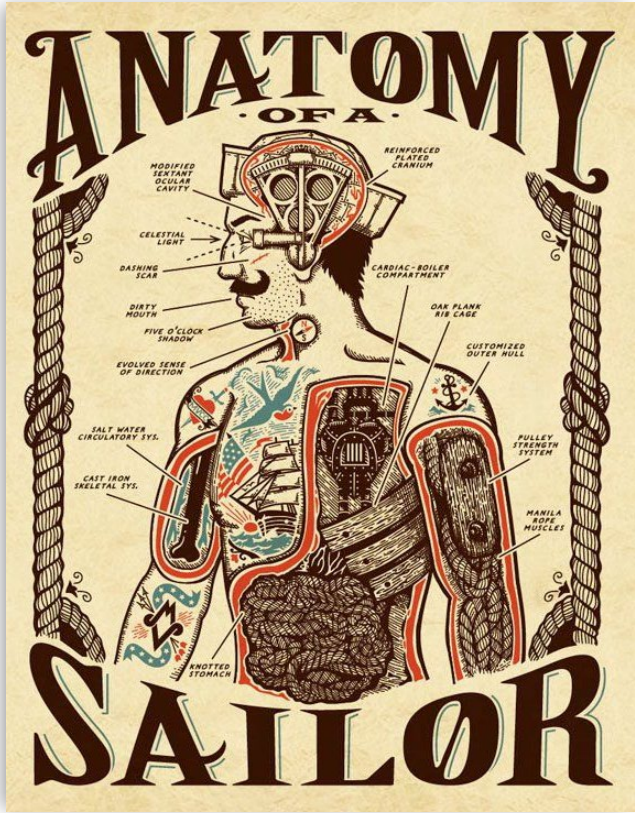
- Intelligent learning system with adaptive learning for maritime simulator training
- Multimodal learning analytics

Background

- Intelligent learning system – enhance learning
- Strong pedagogical foundation
- How does learning happen during simulator training?

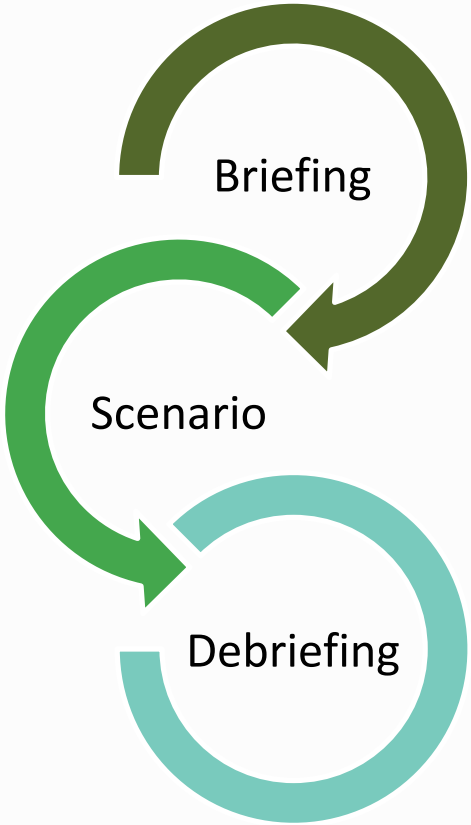
Socio-pedagogical usability

- Simulation-based training is an important part of *becoming* a seafarer, i.e., the process of being *socialized* into the norms and standards of the profession
- Training *as if* working as part of a bridge team in a seagoing vessel
- Important to consider the socialization aspect also in the design process



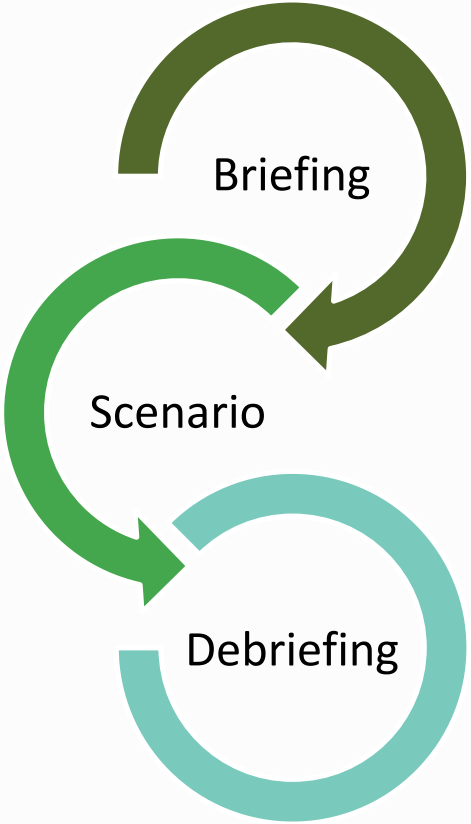
Focus

- Focus on scenario design
- What is good practice for scenario design?
- How do instructors approach scenario design?
- What resources are available to assist with scenario design?
- How can we use our pedagogical expertise to make it even better?



Exploring current practice

- Interviews with 16 instructors from 8 institutions across Sweden, Norway, and Finland
- Observations at 3 of these
- Qualitative analysis of interview transcripts and research notes
- Existing literature – very little available relating to scenario design
- Could a formal instructional design model be applied?



Instructional design models

4C/ID (Kirschner & van Merriënboer, 2008)	Breaks instructional design for complex learning into four components Explicit focus on transfer of learning Holistic approach, based on real-life professional practice
Gagne's Nine Events of Instruction (Gagne et al., 2005)	Focus on conditions for learning Outlines nine steps to facilitating both acquisition and retention of knowledge Provides opportunity for practice of new knowledge and skills
ARCS (Keller, 2010)	Focus on learner motivation Design should capture learners' attention, establish relevance, instill confidence, and provide satisfaction to learners Highlight impact of confidence and success on learner motivation
Dick and Carey (Dick et al., 2009)	Systems approach to instructional design Includes all elements of instruction in an iterative design process Emphasizes interrelationship between context, content, learning, and instruction

Interview findings

- No current framework for scenario design, but instructors approach it very similarly
- Expert knowledge is transferred to students successfully, but no clear explanation of how
- Strong student focus, clear learning objectives, appropriate levels of complexity
- Functional resemblance (plausible illusion)

"The simulator in itself does not provide any training. It's a training tool – Yes. So, you have to use

"You cannot teach them everything at the same time […] So usually, I do it in small steps. Now we're only

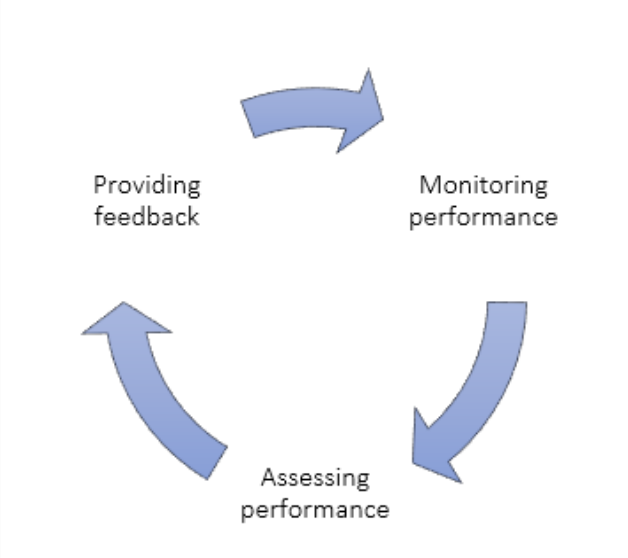
"Once I happened to be listening to a person talking on a telephone and he looked kind of grumpier and

"It's not necessarily so that the, the visual reality or so is that important. It has to be good enough. I sometimes use the, that, you know, if I'll take a photo of you and then I'll make kind of a sketch of you, sometimes, you know, you know, this funny sketch,

"You cannot make them too realistic because you have to balance between the pedagogical approach and the realistic approach. So, I've tried to merge them so I get the fit between that they actually learn what they should learn and not make it too realistic because then sometimes they get too nitty gritty that they actually don't understand the main goal."

Strengths of current approach

- Instructors' experience as an invaluable resource
- Designing scenarios appropriate for students, building upon existing knowledge
- Debriefing providing slightly delayed feedback, which can be more effective than immediate
- Social learning from peers
- Learning from reflection
- Making mistakes in a safe environment

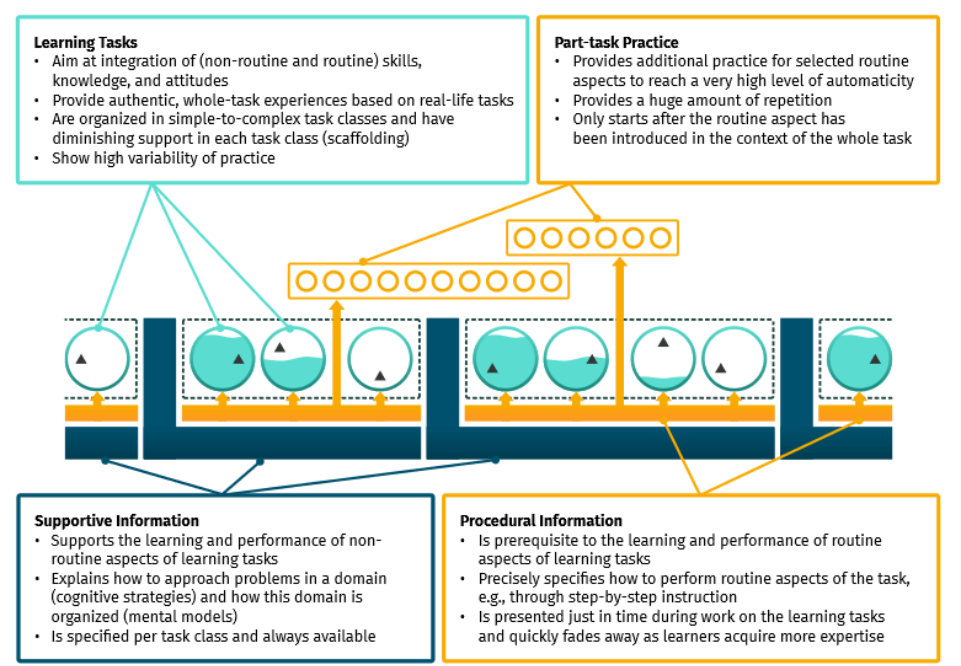


What do we need in an instructional design model?

Factor	Reason	Requirement
Transfer of learning	Common theme in instructor interviews	Realistic learning environment (*plausible illusion*)
Complexity of tasks	High-risk, safety-critical environment requires professionals who can act appropriately in unfamiliar situations	Construction of knowledge that can be drawn upon when required
Student needs	Common theme in instructor interviews	Learning structured by increasing difficulty
Communication of expert knowledge	Difficulty in expressing knowledge that has been automated (e.g., Clark, 2014)	Ability to capture all information required for effective learning

Four-component instructional design

- Development of complex skills or professional competencies
- Focus on transfer of learning to professional practice
- Knowledge, skills, and attitudes
- 10 steps involved



https://www.4cid.org/wp-content/uploads/2021/04/vanmerrienboer-4cid-overview-of-main-design-principles-2021.pdf

4C/ID design principles

Design learning tasks: Realism, fidelity, variability, support, guidance, scaffolding

Set standards for acceptable performance: Skills hierarchy, performance objectives, classify objectives, specify standards, assess performance

Sequence learning tasks on complexity levels: Whole-task learning, backward chaining, individualization, self-directed learning

Design supportive information for non-routine aspects: Supportive information, domain models and mental models, systematic approaches to problem-solving (SAPs) and cognitive strategies, cognitive feedback

Design procedural information and part-task practice for routine aspects: Procedural information, how-to instructions, cognitive rules, prerequisite knowledge, corrective feedback, part-task practice (*if appropriate*)

4C/ID in simulator-based training

1.Learning Tasks

Identify the whole task to be trained. This should be a task or competency that students can expect to perform as a maritime professional e.g., navigation, ship-handling, communication procedures, or emergency response.

Break the task down into manageable chunks, creating clear, measurable, learning objectives

Draw upon real-world events requiring the performance of these tasks. The scenario should be challenging enough to be engaging without being overwhelming, and should provide learners with opportunities for practicing constituent skills

2.Supportive Information

Provide students with background information supporting the tasks, e.g., regulations, relevant theoretical concepts. This should be provided before students attend the simulator, e.g., in a lecture, or in text or multimedia format on a virtual learning environment.

Ensure that this information is integrated into the scenario to facilitate students increasing understanding in context.

4C/ID in simulator-based training

3.Just-in-Time Information

Expert knowledge and real-world experience should be used to identify critical points in the scenario where students may require guidance or additional information

Provide clear, concise information at these critical points, to assist students in making informed decisions or successfully handling challenging events

This information should be made easy for students to access when needed

4.Part-Task Practice*

Break whole tasks into smaller components (part-tasks) that students can practice individually before integrating them into the practice of the whole complex task. This facilitates the automation of part-tasks that will be required regularly in professional practice, *where the whole task does not allow for sufficient practice*.

The part-tasks should first be encountered as the whole task, before being introduced for individual practice. Subsequent scenarios should include repetition of these part-tasks, increasing in complexity to allow students to gradually improve their skills.

Feedback should be provided during part-task practice to correct any errors and encourage good practice

Why use this approach?

- Systematic approach - training for safety-critical environment
- 4C/ID as a formulation of current expert practice
- Enhances strengths of intuitive scenario design based on extensive professional experience
- Makes implicit knowledge explicit
- Framework for an iterative process of designing scenarios suitable for a given context
- New instructors, new simulators…

Ongoing research

- Instructors' professional vision
- Student perception of meaningful feedback
- Participatory learning analytics design workshops
- The learning behind learning analytics

susan.harrington@ait.gu.se